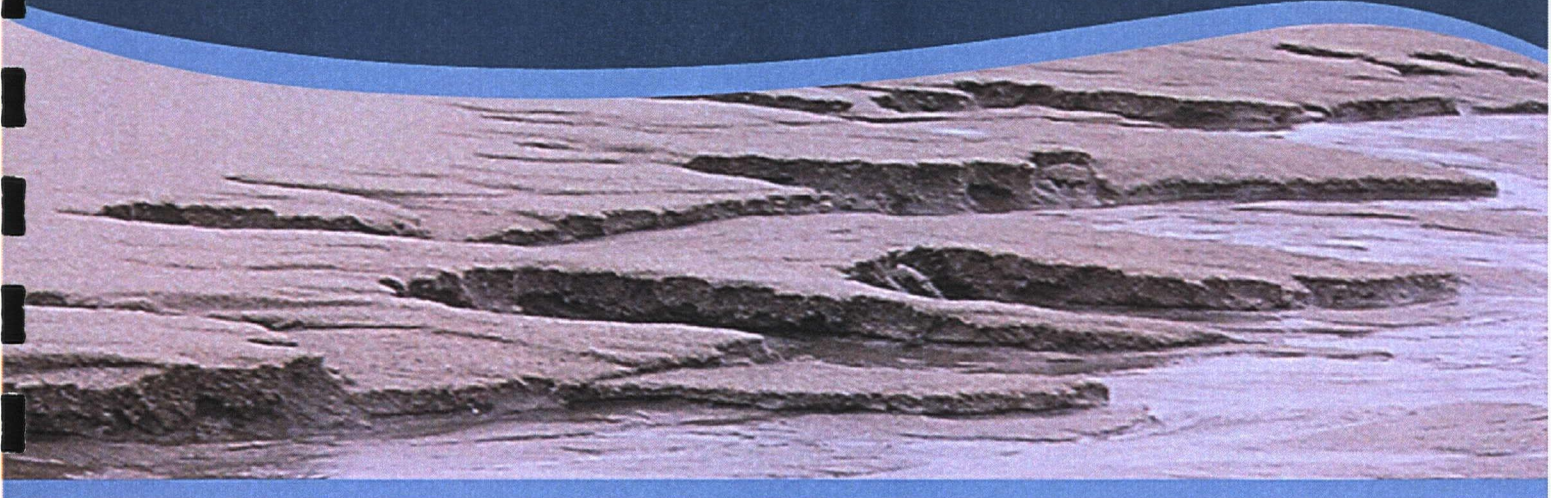


REPORT



11/1/11

BIOLOGICAL ASSESSMENT
JORGENSEN FORGE FACILITY

Prepared for

U.S. Environmental Protection Agency,
Region 10
1200 Sixth Avenue
Seattle, Washington 98101

For Coordination with

National Marine Fisheries Service
U.S. Fish and Wildlife Service

On behalf of

Earle M. Jorgensen Company
10650 South Alameda Street
Lynwood, California 90262

Jorgensen Forge Corporation
8531 East Marginal Way South
Seattle, Washington 98108

Prepared by

Anchor QEA, LLC
720 Olive Way, Suite 1900
Seattle, Washington 98101

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USEPA SF



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LIST OF ACRONYMS AND ABBREVIATIONS

AOC	Administrative Order on Consent
BA	biological assessment
BERA	Baseline Ecological Risk Assessment
Boeing	The Boeing Company
Boeing DSOA	Boeing Duwamish Sediment Other Area
BMP	best management practice
°C	degrees Celsius
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	chemicals of concern
CSL	Cleanup Screening Level
CWA	Clean Water Act
DPS	Distinct Population Segment
DO	dissolved oxygen
DoC	depth of contamination
DOI	Department of the Interior
EAA-4	Early Action Area 4
EE/CA	Engineering Evaluation/Cost Analysis
Ecology	Washington State Department of Ecology
EMJ	Earle M. Jorgensen Company
EPA	U.S. Environmental Protection Agency
EPP	Environmental Protection Plan
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
°F	degrees Fahrenheit
Facility	Jorgensen Forge facility located at 8531 East Marginal Way South in Seattle, Washington
FS	Feasibility Study
Jorgensen Forge	Jorgensen Forge Corporation
LAET	Lowest apparent effects threshold
LDW	Lower Duwamish Waterway

LWD	large woody debris
H:V	Horizontal to vertical
mg/L	milligrams per liter
mg/kg	milligrams per kilogram
MLLW	mean lower low water
MOU	Memorandum of Understanding
NMFS	National Marine Fisheries Service
NRDA	Natural Resource Damage Assessment
NTCRA	non-time-critical removal action
NTU	nephelometric turbidity units
OC	organic carbon
OHWM	ordinary high water mark
PAH	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyl
PCE	primary constituent element
ppb	parts per billion
ppm	parts per million
ppt	parts per trillion
RAB	Removal Action Boundary
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RM	River Mile
ROD	Record of Decision
RTK	Real Time Kinematic
RvAL	Removal Action Level
SMS	Sediment Management Standards
SMU	Sediment Management Unit
SQS	Sediment Quality Standard
SVOC	semivolatile organic compound
TOC	total organic carbon
Trustees	Elliott Bay Natural Resource Trustees
TSCA	Toxic Substances Control Act
TSS	Total Suspended Solids

USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WQC	Water Quality Certification
WRIA	Water Resource Inventory Area

1 INTRODUCTION AND BACKGROUND

This Biological Assessment (BA) is an update to the Preliminary Draft BA that was Appendix A to the Final Engineering Evaluation/Cost Analysis (EE/CA) and that assisted the U.S. Environmental Protection Agency (EPA) in its review of the EE/CA removal action alternatives. This version of the BA provides an analysis of potential effects to Endangered Species Act (ESA)-listed species that may be caused by the preferred removal action alternative and will be used by EPA for consultation with the Services (National Marine Fisheries Service [NMFS] and U.S. Fish and Wildlife Service [USFWS]).

On July 10, 2003, Earle M. Jorgensen Company (EMJ) entered into the Administrative Order on Consent (AOC; EPA Docket No. CERCLA-10-2003-0111) with the EPA to conduct an investigation to determine whether the Jorgensen Forge Corporation (Jorgensen Forge) facility located at 8531 East Marginal Way South in Seattle, Washington (Facility), is or has been a source of polychlorinated biphenyls (PCBs) to Early Action Area 4 (EAA-4) within the Lower Duwamish Waterway (LDW) adjacent to the Facility. Sampling and analysis conducted by EMJ detected concentrations of PCBs and metals in the sediments and shoreline bank materials within EAA-4 adjacent to the Facility. EPA determined that the detected chemical concentrations within a portion of EAA-4 adjacent to the Facility meet the criteria for initiating a non-time-critical removal action (NTCRA) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA; EPA 2008a).

For this reason, EPA and EMJ entered into the First Amendment to the AOC (EPA Docket No. CERCLA-10-2003-0111, 2008), which requires EMJ to complete the permitting, design, and construction of the preferred removal action alternative for affected sediments and associated shoreline bank within the EAA-4 adjacent to a portion of the Facility identified as the Removal Action Boundary (RAB). As part of the permitting activities, this BA, and a Clean Water Act (CWA) Section 404(b)(1) Evaluation are required. The RAB is defined by the area where sediment chemical concentrations exceed the Washington State Department of Ecology (Ecology) Sediment Management Standard (SMS) Sediment Quality Standard (SQS) criteria and accounts for a number of site-specific characteristics discussed in Section 4.2.2 of the Final EE/CA. EPA approved the RAB in a letter dated August 8, 2008 (EPA 2008b). In addition, EPA directed the use of the SQS for total PCBs (12 milligram per

kilogram [mg/kg] normalized for organic carbon [OC] content) as the appropriate removal action level (RvAL) for sediment removal and/or capping in the RAB (EPA 2010) to facilitate development of the Final EE/CA prior to completion of the Record of Decision (ROD). Additionally, EPA directed that all PCBs that exceed the RvAL will need to be removed or permanently capped (EPA 2010).

EPA issued an Action Memorandum which was received on October 13, 2011, selecting the full removal alternative (Alternative 4 in the Final EE/CA) for the removal action. With issuance of the Action Memorandum, this document was updated to include relevant information from both the Action Memorandum and the Final EE/CA, including information gathered during ongoing bi-monthly coordination meetings with The Boeing Company (Boeing). Under the Resource Control and Recovery Act (RCRA), Boeing is conducting an interim sediment corrective action in an area adjacent to and north/downstream of the RAB known as the Boeing Duwamish Sediment Other Area (Boeing DSOA).

1.1 Project Setting

The removal action will address sediments and the associated shoreline bank within the EAA-4 adjacent to the Facility on the eastern shoreline of the LDW, at approximately River Mile (RM) 3.6 (Figure 1). The removal action is proposed to occur within the EPA's LDW Superfund Site. The Superfund Site extends from the mouth of the LDW to approximately RM 5, approximately 1.4 miles upriver from the Facility.

The setting of the LDW is heavily industrialized and the river shoreline is degraded throughout most of its length—especially within the first 5 miles inland from the mouth of the LDW, along the length containing the federally maintained navigation channel. The Duwamish River was historically an estuarine wildlife habitat and remains an important migration corridor for several salmonid species listed under ESA. The LDW is a transitional zone where anadromous fish migrate from freshwater streams to the ocean. The LDW lacks suitable habitat for out migrating juvenile salmonids, as the shoreline is characterized by few shallow water areas with places for salmon to rest and feed.

1.2 Removal Action Boundary and Action Area

The terms RAB and Action Area are used in this BA to discuss geographic areas relevant to the project. RAB is a project boundary for the removal action identified in the Final EE/CA, while Action Area includes the area potentially affected directly or indirectly by the proposed removal action. The basis for the Action Area takes into consideration removal action activities that pose potential impacts to listed species and their habitats. For this project, these activities include dredging, backfill and shoreline bank reconfiguration, which can result in the temporary resuspension of sediments, shoreline soils, or contaminants in the water column.

Based on an evaluation of sediment chemistry and operational and engineering considerations, the EPA-approved (EPA 2008b) RAB is defined by the sediments and shoreline bank adjacent to the Facility shown in Figure 2 and bounded by the following:

- To the north/downstream by the in-water and shoreline bank sediment cleanup boundaries identified in the EPA-approved Memorandum of Understanding (MOU; EMJ et al. 2007)
- To the west by the federal navigation channel, as well as a small 20-foot extension into the channel in one location adjacent to sediment sampling station SD-DUW322
- To the south by the extension of the southern Facility property boundary into the LDW
- To the east by the top of the shoreline bank slope along the central and northern portions of the Facility and the top of the sheetpile/concrete panel wall on the southern portion of the Facility

The Action Area is defined as the area to be affected directly or indirectly by the federal action (50 CFR §402.02). For this project, the action includes dredging and subsequent placement of backfill, and shoreline reconfiguration. Some of these activities could result in the temporary resuspension of sediments or contaminants in the water column. If the proposed activities are conducted during a time when no additional cleanup actions are taking place within the RAB, the Action Area will be defined as the aquatic area within a 0.5-mile radius surrounding the proposed construction activities, as shown on Figure 2. This distance is chosen to be conservative to include all potential aquatic impacts related to the proposed actions.

1.3 Project Timing

Federal and state agencies have established work windows to be protective of potential effects to salmonids due to construction activity. In-water work is typically required to occur during these windows, when salmonids are unlikely to be present in the Action Area or may be present in low numbers. In the LDW, the Washington Department of Fish and Wildlife (WDFW) has recommended the following in-water work windows:

- **Salmon:** July 2 to March 2
- **Bull Trout:** October 1 to February 15
- **Surf Smelt:** April 1 to August 31
 - Does not apply because there is no surf smelt spawning habitat (that is, sand/gravel substrate in the intertidal and upper intertidal area) in the project area
- **Pacific Herring:** May 1 to January 14
 - Does not apply due to there not being any herring spawning habitat (that is, eelgrass) in the project area
- **Sand Lance:** March 2 to October 14
 - Does not apply due to there not being any sand lance spawning habitat (that is, sand/gravel substrate in the intertidal and upper intertidal area in the project area)

For these reasons, the window that applies to this work is October 1 to February 15 to account for salmon and bull trout species that could be impacted by the proposed project. The project is expected to span approximately 4.5 weeks of in-water work and will take approximately 8 weeks to complete. The specific project timing details will be developed for the proposed action by the selected contractor as part of the removal action work plan documents.

Another timing consideration is the Muckleshoot Tribe's net-fishing activities, as the proposed action will occur within a netfishing area. As stated in the LDW Draft Final Feasibility Study (FS) (AECOM 2010), the Muckleshoot Tribe's netfishing activities within the LDW over the last few years have sometimes extended through October and well into November, which extends into the in-water work period. EMJ and Jorgensen Forge, in

coordination with EPA, will work closely with the Muckleshoot Tribe prior to and during implementation of the proposed action to limit the conflicts between remediation and netfishing activities.

To reduce potential impacts associated with neighboring cleanup activities, the MOU requires that the adjacent Boeing DSOA corrective action and EMJ and Jorgensen Forge removal action occur concurrently, to the extent feasible. The Boeing DSOA corrective action is currently in the design phase with a target construction date of 2012. Delays in planning and design phases of these concurrent projects may result in delays to initiation of the removal action at the Facility.

2 PROJECT DESCRIPTION

This section describes the proposed action, including methods for construction and measures that will be taken to minimize impacts to listed species.

2.1 Proposed Action

The proposed action consists of the preferred removal action alternative, which was selected by EPA following the integration of EPA and public comments on the Final EE/CA. The preferred alternative was formally identified and selected as the clean up remedy for the Facility in an Action Memorandum prepared by EPA, which was received on October 13, 2011. This BA describes the preferred removal action alternative as the proposed action. The purpose of the proposed action is to remediate sediments to reduce risks to human health and the environment to acceptable levels.

To assist with the development and evaluation of cleanup alternatives, the area within the RAB was divided into the 11 Sediment Management Units (SMUs)¹ shown in Figure 3. Similar to the Final EE/CA, this document refers to excavation as removal of material in-the-dry, typically using land-based construction equipment from the upland side of the Facility. Dredging refers to removal of material from the waterside, typically using equipment mounted on barges.

EPA required that each of the potential cleanup alternatives, including the preferred alternative, account for future navigational dredging within the federal navigation channel, which constitutes the western edge of the RAB. The regulated navigational depth is -15 feet mean lower low water (MLLW). Review of the existing elevations shows that the current mudline elevations along the eastern boundary of the navigation channel are generally above this elevation, indicating that dredging may be required in the future.

The proposed action is shown on Figures 3 and 4 and consists of the following activities, which are described in more detail in the following sections:

- Bank excavation and containment

¹ SMUs 1 and 4 are further divided into sub-SMUs.

- Complete removal of total PCB RvAL exceedances followed by backfill placement
- Subtitle D disposal of excavated and dredged material
- Additional activities

2.1.1 Bank Excavation and Slope Containment

The shoreline bank will be excavated to remove nearshore affected soils/sediment, followed by the placement of a 4-foot slope containment including bank armoring and overlying sand and gravel mixture to promote slope stability, enhance habitat, and contain underlying contaminated fill in SMU-3, SMU-5, SMU-8, and SMU-11 (Figure 3). This portion of the shoreline is degraded, containing elevated chemical concentrations above the SQS criteria, highly armored, and over steepened (approximately 1:1 horizontal to vertical [H:V]) slope) banks, derelict creosote-treated piles, remnant overhanging asphalt pads, and other types of debris. The shoreline also generally lacks riparian cover except along the top of bank. No shoreline reconfiguration is proposed in SMU-1, which is abutted by the adjacent sheet pile and concrete panel walls.

SMU-3, SMU-5, SMU-8, and SMU-11 have been identified as potential contaminant sources to nearshore sediments due to bank soil/sediment SQS exceedances and the general presence of debris in these areas. Bank excavation and subsequent placement of slope containment would prevent the elevated chemical concentrations from entering the aquatic environment. The habitat condition in SMU-3, SMU-5, SMU-8, and SMU-11 following completion of the reconfiguration will be substantially improved over existing conditions, described as follows.

The proposed bank reconfiguration extends from the top of the existing bank from approximately +19 to +20 feet MLLW down to 0 to +2 feet MLLW elevation. The lower elevation range was used for planning purposes in the Final EE/CA and was selected based on tidal variations and the reach length of typical long reach excavators. These excavation and containment activities will be performed from the landside during low tides below the 0 to 2 feet MLLW elevation range to the extent practicable to accomplish this work in-the-dry.

Existing derelict overhanging asphalt structures and debris will be removed from the bank prior to excavation and placement of slope containment. Upon excavation to the target depths, inert debris identified along the new surface may be allowed to remain in place if it is

determined that it would not affect the function of the overlying slope containment. An estimated 90 tons of debris would be removed and disposed of off-site.

The shoreline excavation is proposed to occur over a total distance of 605 linear feet. The design excavation depth is 4 feet (including 1-foot excavation tolerance) shoreward of the existing ground surface from the toe of slope upwards, with the resulting slope reconfigured to a gentler, more stable 2H:1V slope (Figures 3 and 4). The excavation will result in the removal of approximately 6,000 cubic yards of impacted soil/fill and sediment, debris, and other encountered material, and would create a gentler slope with increased intertidal habitat.

Following excavation, slope containment materials will be placed along the full length and height of the reconfigured slope. Based on experience at similar sites, the containment will be composed of a target 30-inch "filter" layer (sandy gravel to gravelly sand), overlain by a target 12-inch "armor" layer (riprap or cobble), further overlain by a target 6-inch layer of material augmented with habitat substrate (anticipated to consist of washed, 2-inch minus gravel). The filter layer will act as the chemical isolation layer, the armor layer will function to protect the filter layer from erosion, and the habitat layer will provide the appropriate substrate for benthic invertebrate and salmonid habitat. Application of the slope containment will result in the placement of approximately 2,200 cubic yards of filter layer, 900 cubic yards of armor layer, and approximately 300 cubic yards of a habitat layer (for a total placement volume of approximately 3,400 cubic yards) over approximately 0.38 acre. The amount of armor material required will be minimized as much as possible during design to maximize habitat considerations while ensuring erosion protection.

The specific containment materials and configuration of the bank excavation will be determined during design. The bank caps will be designed in general accordance with applicable EPA and U.S. Army Corps of Engineers (USACE) capping guidance and will include an evaluation of slope stability, propeller wash scour, isolation effectiveness for the identified chemical concentrations below the cap, erosion during design river discharge events, and seismic stability. For the purposes of the Final EE/CA, the maximum shoreline containment slopes (2H:1V) and materials identified were consistent with regional embankment designs that meet modeled and proven seismic stability. During design,

appropriate seismic design criteria will be developed, and slopes and/or materials may be modified to ensure seismic stability.

2.1.1.1 Construction Methods

The expected construction method for bank reconfiguration is land-based excavation and placement of slope containment in-the-dry, due to the advantages specified in Section 5.4.1.1 of the Final EE/CA.

Existing derelict creosote-treated piles and debris will be removed within the shoreline area prior to excavation and slope containment (see Section 6.2.1.1 of the Final EE/CA). Piles will be removed intact, if possible, using either vibratory extraction or dead-line pull methods. Piles that cannot be removed intact will be cut at or near the mudline. Following the excavation, some inert debris embedded in the shoreline beneath the design depth may remain in place if it is determined that it would not affect the function of the containment. Removed piles and debris will be disposed at a permitted landfill.

The excavation is expected to be completed with land-based earthmoving equipment (for example, excavators, front-end loaders, and dump trucks) to the extent possible based on equipment availability and water surface elevations. The contractor will be allowed at least a 1-foot over-excavation allowance to account for equipment tolerances. Impacted material is anticipated to be excavated, temporarily stockpiled at the Facility in an area that adequately contains the material, and then transferred into trucks and/or rail cars for transport to the selected permitted offsite disposal facility.

No bank or upland soils have been documented with total PCBs greater than the Toxic Substances Control Act (TSCA) landfill trigger concentration (50 mg/kg); therefore, it is assumed that all excavated soils and sediments will be designated as non-hazardous/non-dangerous and disposed at a Subtitle D landfill. These landfills have the ability to receive soil or wet dredged sediment delivered by rail. Both types of facilities must have also received the required EPA approval for acceptance of sediment and soil generated at CERCLA sites.

The slope containment is planned to be completed with the same type of land-based equipment used for the excavation. Clean (as defined in the Action Memorandum [EPA

2011]) containment material is expected to be imported by land from the borrow quarry to the RAB with dump trucks or by water on barges. The containment material will then be placed as engineered fill over the impacted soil and sediment. The containment, armor, and habitat layer materials are anticipated to be placed in-the-dry to the extent practicable based on the water surface elevations during construction. The contractor will be provided a minimum 0.5-foot overplacement allowance to account for equipment tolerances.

If the bank excavation is conducted concurrently with the Boeing DSOA cleanup, construction in SMU-11 will be sequenced to limit excavation residuals and recontamination due to construction-related activities in either cleanup area and to ensure the target dredge depths, slope connections, and grades match along the toe of the riprap cleanup boundary.

2.1.1.2 Impact Avoidance, Minimization, and Conservation Measures

Impact avoidance, minimization, and conservation measures that may be applied to this work include:

- A sand and gravel habitat layer will be placed on top of the cap armor layer to enhance substrate for benthic invertebrates, which are prey for juvenile salmonids. The habitat material will also fill in the interstitial spaces between the cap armor, which will remove potential hiding places for salmonid predators.
- The slope containment, armor, and habitat layer materials are anticipated to be placed in-the-dry to the extent possible.
- To ensure proper containment placement, in situ cap materials will be placed in a controlled and accurate manner.
- Bathymetry information may be used in deeper areas to verify adequate coverage during and following material placement.
- Sediment containment materials will be imported material that contains chemical concentrations at or below natural background chemical concentrations, as defined in the Action Memorandum (EPA 2011).
- Surface booms, oil-absorbent pads, and similar materials will be on-site for any sheen that may occur on the surface of the water during construction.
- If there is contaminated excavated material following construction that requires stockpiling and landfill disposal, proper sediment and erosion control methods will be

implemented to contain the material and prevent any material from re-entering the LDW.

- In addition to these measures, other conservation measures may be implemented as described in Section 2.2.

2.1.2 Sediment Dredging

The purpose of sediment dredging is to remove surface and subsurface sediments exhibiting elevated concentrations of chemicals of concern (COCs) within the RAB and to dispose of them at an EPA-approved upland landfill. This removal would serve to eliminate:

1. Exposure to the highest risk surface sediments within the RAB
1. A significant mass of contaminated sediments at depth from within the RAB

All in-water sediments with concentrations greater than the total PCB RvAL will be removed with subsequent backfill to grade as follows:

- SMU-1A: 1-foot removal and 1-foot backfill
- SMU-1B, SMU-4A, and SMU-9: 5.5-foot removal and 5.5-foot backfill
- SMU-2: 10.5-foot removal and 10.5-foot backfill
- SMU-4B: 8-foot removal and 6-foot backfill
- SMU-4C: 9.5-foot removal and 9.5-foot backfill
- SMU-7 and SMU-10: 2-foot removal and 2-foot backfill
- SMU-6: 4-foot removal and 4-foot backfill

Removal adjacent to the sheet pile and concrete panel walls will be offset from the wall by 5 feet to minimize potential impacts to the structural stability of the walls.

The dredge design is based on surface and subsurface exceedances of the total PCB RvAL (12 mg/kg OC). All other elevated concentrations of COCs within these SMUs are expected to be remediated upon removal of total PCB concentrations above the RvAL. The dredging will target the removal of the full depth of total PCB RvAL exceedances within each of the in-water SMUs based on the existing subsurface core data. Based on current information, the dredge cuts will vary in thickness between 1 and 10.5 feet and the contractor will be allowed an additional overdredge tolerance of 1 foot.

Post-dredge bathymetric surveys will be performed to confirm contractor estimates of sediments removed from the target areas and to ensure that target depths are achieved. If the post-dredge survey shows that the target elevations were not achieved, the contractor will perform the necessary additional dredging. A final post-dredge survey will be performed to document the post-construction mudline elevations. Approximately 17,000 to 22,000 cubic yards of material is expected to be removed during dredging.

Dredging in all areas except SMU-4B will be followed by the placement of clean material to bring the area back to existing grade. The final elevations in the near channel portions of these SMUs will not be brought back to grade due to requirements to accommodate potential future maintenance dredging by the USACE within and directly adjacent to the federal navigation channel. The clean backfill material is anticipated to increase the habitat quality of the post-construction surface through placement of habitat substrate (for example, 2-inch minus material) in the upper 6 inches. Backfill areas will have no long-term monitoring requirements, unless required by EPA to provide an evaluation of surface sediment concentrations based on ongoing river-wide sources of chemical concentrations. If required, this monitoring data would not trigger any corrective actions if upland sources from the Facility are documented as controlled.

2.1.2.1 Construction Methods

Dredging is anticipated to be completed using mechanical methods. Specifically, as discussed in Appendix E of the Final EE/CA (Anchor QEA 2011), dredging is expected to be performed using an excavator with an articulated, enclosed bucket, to the extent possible. Large debris piles that have been identified in the removal action area, such as trees, large concrete blocks, intact and broken pilings, and molten debris piles, are likely beyond the lifting capacity of this type of bucket. In areas where this type of bucket is unable to remove the encountered material, a heavier bucket with digging capabilities or a conventional wire-supported clamshell dredge, grapple, or vibratory hammer would be necessary. The dredge cuts in each SMU are expected to extend from the target dredge elevation out to the adjacent SMU boundary or federal navigation channel with temporary side slopes of 3H:1V (in-water) to 2H:1V (toe of shoreline bank) and daylight at the existing mudline or post-construction

surface. The selected contractor will be allowed at least a 1-foot overdredge allowance to account for equipment tolerances.

The sediments removed during dredging will be placed on a barge equipped to hold dredged material and water and transported to and offloaded at an EPA-approved offloading facility. (See Section 2.1.2.2 for more details related to dredge water management). The contractor will arrange and coordinate the offloading site, which is expected to be located on the LDW. If a suitable offloading, rehandling, and dewatering site cannot be found nearby, it is possible that the dredged sediments could be loaded directly into containers that could be directly loaded onto truck chasses or railcars. If a suitable offloading, rehandling, and dewatering site is identified, the material on the barge would be offloaded and treated, if necessary, to reduce water in the sediment prior to placement into trucks or railcars, or the material would be offloaded directly into trucks or railcars for transportation to an approved landfill. If testing reveals that the material is suited for daily cover, such beneficial use would be sought at that time.

Existing sampling information indicates that all of the dredged material in the RAB would have total PCB concentrations less than 50 mg/kg (concentration trigger for TSCA landfill disposal). Therefore, all dredged material will be disposed of in a permitted RCRA Subtitle D landfill that meets state and federal requirements for properly disposing of PCB-contaminated solids. Pursuant to the AOC, written notification will be provided (prior to any off-site shipment of hazardous substances from the Facility to an out-of-state waste management facility) to the appropriate state environmental official in the receiving state and to EPA's designated project coordinator of such shipment of hazardous substances. The notification of shipments shall not apply to any off-site shipments when the total volume of such shipments will not exceed 10 cubic yards.

2.1.2.2 *Impact Avoidance, Minimization, and Conservation Measures*

Impact avoidance, minimization, and conservation measures that will be applied to this work are described as follows.

The following measures were provided in Appendix E of the Final EE/CA (Anchor QEA 2011) as measures identified for the removal action to reduce suspension of sediment into the water column during dredging while maintaining productivity.

- Develop a dredging plan that accurately identifies the extent of the target material for removal during a single dredge event.
 - An accurate digital terrain model for the depth of contamination (DoC) elevation to be removed during dredging will be developed using the results of the completed sediment coring program, in combination with geospatial analysis. The purpose of accurately measuring DoC elevation is to characterize the extent of the target material with a high degree of confidence for input into the dredge plan.
 - The DoC terrain model, plus an allowance for dredge accuracy and tolerance, will be used to develop an accurate digital terrain model of the design dredge elevation. The purpose of accurately measuring design dredge elevation is to develop a dredging plan with a high degree of confidence that the target material will be removed efficiently in a single dredging event.
- Dredging will be performed to the design dredge elevation in a single dredge event for each dredge sub-unit, as verified by periodic bathymetric surveys. Performing a single dredging event relies on implementation of the design dredge elevation best management practice (BMP), so that each subarea can be dredged to the required elevation, verified with bathymetric surveys, and then immediately covered without the need to wait for results from confirmation chemical testing. This BMP also allows the dredged area to be quickly covered, reducing the potential for ongoing resuspension and release from the loosened residual sediment.
- A clean sand cover (3 to 6 inches) will be placed over dredge cuts in each subunit (size to be determined during the remedy design process) of the site in a timely manner, as soon as practical, after dredging of the subunit is complete. This placement will limit the potential for resuspension and release of sediment from the loosened post-dredging residual material.
 - Phase additional backfilling, as appropriate, once all upstream and adjacent dredging is complete.
 - The final layer of backfill may be scheduled to occur after all dredging is complete.

- An enclosed environmental type bucket will be used to the extent possible to limit sediment loss and resuspension during dredging activities; however, for certain conditions (e.g., large pieces of debris are present, hard substrates, piling removal), an enclosed bucket may not work properly so an alternative bucket type (e.g., digging or a clamshell bucket) may be necessary. Sub-foot accuracy GPS will be used for accurate bucket positioning.
- Stair-step dredge cuts for steeper slopes will be implemented to reduce sloughing of sediment, which reduces the formation of generated residuals, and reduce the potential for resuspension and release.
- An excavator dredge will be used, as appropriate, for improved bucket control on steeper slopes. The purpose of dredging steeper slopes using an excavator, as opposed to a cable-deployed bucket, is to limit the disturbance of impacted sediment on the slope during dredging, and, in turn, limit resuspension and release.
- The direct overflow of water in sediment haul barges back to the waterway without prior processing and management as dredging return water will be prohibited. The purpose of the water management is to limit the release of sediment back into the waterway from the sediment haul barge. Implementation of the water management BMP for the proposed action will involve either the active pumping of the excess water from the sediment haul barges or the addition of dewatering agent (for example, Portland cement, lime kiln dust, or diatomaceous earth) to limit the amount of ponded water within the barge and prevent direct overflow from the barge back to the waterway. Any removed water would be pumped to a water management system designed to remove excess sediment prior to discharge of the water back to the waterway as dredging return water (in accordance with the appropriate permits). With proper capture and management, the turbid water placed in a barge by the enclosed dredging bucket can be processed to remove suspended sediment that would otherwise be released back into the waterway, causing releases.
- Intertidal sediment and shoreline bank soil excavation will be conducted in-the-dry to the degree reasonably possible using land-based equipment. Intertidal sediment and shoreline bank soil excavation in-the-dry reduces the potential for release of impacted intertidal sediment and shoreline bank soils to the waterway by removing the sediment accessible from the upland when the tides are out and the sediment is exposed. Low tides during the in-water construction window occur during night

hours, although EPA is currently limiting all cleanup activities to occur from 7 a.m. to 6 p.m., with possible extension to 9 p.m. for consistency with the City of Tukwila noise ordinance. This BMP includes the use of shoreline-based excavation equipment that is working at least 2 feet back from the actual water line at all times. Excavation in-the-dry avoids exposure of the sediment and soils to the water column during the period of disturbance by the removal equipment, thereby eliminating suspension of sediment and soil particles into the water column during removal. In addition, since no water is present during removal, formation of a low-strength residual slurry associated with excavation is limited.

Additional measures that will be implemented during dredging to minimize impacts include the following:

- During transport and handling of sediment, adequate containment measures and inspections will be employed to minimize spillage of material into the surface water.
- Bottom or beach stockpiling will be avoided at all times.
- Taking multiple bites with the dredge bucket will be avoided at all times.
- Overfilling of the bucket will be avoided at all times.
- If water quality monitoring identifies parameter measurements above corrective action triggers, dredging rates (time period of dredge and placement cycles) will be regulated to the extent practicable.
- Standard barge loading controls will be observed including no barge overfilling. The barge would be loaded so that enough freeboard remains to allow for safe movement of the barge and its material on its planned route.
- Equipment such as fuel hoses, oil drums, and oil or fuel transfer valves and fittings will be checked regularly for drips or leaks and will be maintained to prevent spills to the river.
- All dredge areas will be backfilled to grade with a sand and gravel habitat material except in SMU 4B, which, for navigation purposes, will only require 6 feet of backfill material rather than the 8 feet that are being removed.
- In addition to these measures, other conservation measures will be implemented as described in Section 2.2.

2.1.3 Backfill

Upon completion of the dredging activities, the dredged areas will be backfilled to grade, except in SMU-4B as previously noted. The backfill material will be habitat-friendly and consist of a sand and gravel mixture. Following the placement of the backfill material, a bathymetric survey of aquatic areas will be completed to verify and document that the cover meets the design specification with allowable overplacement.

2.1.3.1 Construction Methods

Due to the mudline elevations within SMU-1A, SMU-1B, SMU-2, SMU-4A, SMU-4B, SMU-4C, SMU-6, SMU-9, and SMU-10, the backfill activities will be staged from the water side working at higher tides as needed to provide the required draft for the equipment. Backfill materials are anticipated to be placed mechanically from a barge using a clamshell bucket. The material will be placed with sufficient control to meet the design thickness and the contractor would be given at least a 6-inch overplacement allowance to account for equipment tolerances. Following the placement of the backfill material, a bathymetric survey of aquatic areas will be completed to verify and document that the placed thickness meets the design specification.

2.1.3.2 Impact Avoidance, Minimization and Conservation Measures

Impact avoidance, minimization and conservation measures that may be applied to this work are the same as those applying to slope containment (as described in Section 2.2.1.2). Other conservation measures will be implemented as described in Section 2.2.

2.1.4 Piling Removal

Approximately 40 pilings will be permanently removed from within the intertidal portions of the RAB using vibratory extraction, direct pull methods, or will be cut at the mudline. The existing pilings are creosote-treated and will not be re-installed after the removal action.

2.1.4.1 Construction Methods

Piling removal is expected to be conducted with a crane mounted on a barge. If a piling is unable to be completely removed using the vibratory or pulling methods, the piling will most likely be cut at the mudline.

2.1.4.2 Impact Avoidance, Minimization and Conservation Measures

Impact avoidance, minimization and conservation measures that will be applied to this work include the following:

- For the removal of creosote-treated pilings, methods to contain and collect floating debris will be implemented. Typical methods include placement of a containment boom around the work area and retrieval and proper disposal of any debris.
- All creosote-treated material will be disposed of in a landfill approved to accept those types of materials.
- Piling will be removed in a way that minimizes sediment disturbance and turbidity in the water column.
- If a pile breaks above the mudline, it will be cut at the mudline.
- Other conservation measures will be implemented as described in Section 2.2.

2.1.5 Additional Activities

Additional activities that may potentially occur concurrent with the removal action include construction of a restoration project as part of the EMJ and Jorgensen Forge Natural Resource Damage Assessment (NRDA) settlement with the Elliott Bay Natural Resource Trustees (Trustees), excavation to remove contaminated soils and corrugated metal pipe at the discharge of the inactive property line outfalls located along the Boeing Plant 2 and Facility property lines, and improvements to the existing Facility stormwater discharge structures.

Technical analyses and agency negotiations are currently being conducted for each of these activities to determine a path forward for inclusion as elements of the overall sediment and shoreline bank cleanup of the Facility. As these final analyses and negotiations are completed and design plans are further developed for these activities, an addendum to this BA will be prepared and provided to EPA. The BA addendum will provide an analysis of potential impacts to ESA-listed species related to these additional activities.

2.2 General Conservation Measures

In addition to conservation measures previously described for each proposed action element, the general conservation measures anticipated to be followed during the removal action are outlined in this section.

- Water quality in the project area will be monitored and compared against all applicable water quality standards to comply with the Water Quality Certification (WQC) for the removal action.
- Due to the potential vessel traffic in the dredging and backfill areas, operational controls (as opposed to a silt curtain or similar device) are considered the most effective measure for control of turbidity. For example, construction activities can be progressively slowed until turbidity exceedances are no longer detected outside of the compliance boundary to minimize sediment suspension, or dredging cycle times can be shortened to decrease turbidity plumes until the suspended sediment settles.
- In-water work for this project will comply with the timing restrictions specified in the in-water work window, when salmonids are expected to be either not present or present only in very low numbers. In the LDW, the in-water work window extends annually from October 1 to February 15 (the USACE work window); thus, in-water construction activities would occur between these dates.
- Operations will be stopped temporarily if listed species are observed as injured, sick, or dead in the project area to determine whether additional fish are present and to ensure that operations may continue without further impact. NMFS Law Enforcement will be notified, and fish will be handled with care to ensure effective treatment or analysis of cause of death or injury.
- Prior to entering the water, all equipment will be checked for leaks and cleaned of any external petroleum products, hydraulic fluid, coolants, and other deleterious materials.
- A spill containment and control plan will be kept on site during construction activities and will contain notification procedures, specific cleanup and placement instructions for different products, quick response containment and cleanup measures that will be available, proposed methods for placement of spilled materials, and employee training for spill containment.

- The contractor will establish an Environmental Protection Plan (EPP), which prevents environmental pollution and minimizes environmental degradation during and as a result of construction operations, including consideration of noise levels, air, water, and land. The EPP will establish and maintain quality control for environmental protection of all proposed actions. Erosion and turbidity control measures will also be included in the EPP.

3 SPECIES ACCOUNTS AND USE OF THE ACTION AREA

Species under both NMFS and USFWS jurisdictions are addressed in this BA. NMFS has identified threatened Puget Sound Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead (*Oncorhynchus mykiss*) as potentially occurring in the project vicinity (NMFS 2008; Table 1). USFWS has identified threatened Coastal-Puget Sound bull trout (*Salvelinus confluentus*) as potentially occurring in the project vicinity (USFWS 2008; Table 1).

Table 1
Species and Critical Habitat with Federal ESA Status That May Occur in the Action Area

Common Name (Scientific Name)	Jurisdiction	ESA Status	Critical Habitat
Chinook salmon (<i>Oncorhynchus tshawytscha</i>) Puget Sound ESU	NMFS	Threatened	Designated
Steelhead (<i>Oncorhynchus mykiss</i>) Puget Sound DPS	NMFS	Threatened	Under development; none proposed at this time
Bull trout (<i>Salvelinus confluentus</i>) conterminous Coastal-Puget Sound DPS	USFWS	Threatened	Designated

Notes:

ESU Evolutionarily Significant Unit

DPS Distinct Population Segment

3.1 Puget Sound Chinook Salmon

The Puget Sound Evolutionarily Significant Unit (ESU) of Chinook salmon is listed as threatened by the ESA and includes all naturally spawned populations of Chinook salmon from rivers and streams flowing into Puget Sound, including the Straits of Juan De Fuca from the Elwha River eastward; rivers and streams flowing into Hood Canal, South Puget Sound, North Puget Sound, and the Strait of Georgia in Washington. It also includes up to 26 artificial propagation programs. Most Chinook salmon in this ESU exhibit an ocean-type life history. Ocean-type populations typically migrate to sea as subyearlings prior to age one, utilize estuarine and nearshore habitats for extended periods, often spend their entire ocean residence on the continental shelf, and return to their natal stream in the fall immediately before spawning (Schiewe and Kareiva 2001).

Chinook salmon migrating through the Duwamish River estuary are of the Duwamish/Green River summer/fall population (Good et al. 2005). Spring Chinook were historically present in the Duwamish/Green River basin, but are now considered extirpated (NMFS 2006). The summer/fall Chinook salmon now present in the Duwamish/Green River basin are ocean-type fish that rear in freshwater for a few months before migrating in the spring.

Juvenile Puget Sound Chinook are expected in the Action Area during their rearing and downstream migration beginning in late January and extending through early to mid July, based on a recent study (Ruggerone et al. 2006). Ruggerone et al. 2006 found low catch rates of natural Chinook juveniles from late January through mid-March and higher catch rates from mid-March through late May. In the same study, hatchery Chinook were found in the Action Area in late March and were abundant from late May through early June (Ruggerone et al. 2006). During the early migration period (February through March), Chinook salmon were more abundant in brackish water areas (>2 parts per trillion [ppt]), while from late March through early July, Chinook were more abundant in fresh water habitats (<2 ppt) (Ruggerone et al. 2006). These observations suggest that the early migrating Chinook fry (February to March) move rapidly through the lower river (low salinity) and hold in the brackish water areas while later migrating fingerlings hold and rear in the lower river habitats (low salinity) and move rapidly through brackish water areas (Ruggerone et al. 2006). Juvenile Chinook are typically present in the LDW from approximately a few days during early February to up to 2 months (Grette and Salo 1986).

Adults are expected to be present during their upstream migration in late June into early November, with large numbers entering the river by July (Williams et al. 1975; Frissell et al. 2000; Kerwin and Nelson 2000), and with many early immigrating Chinook salmon holding in the lower river until approximately mid-September (Ruggerone and Weitkamp 2004; Ruggerone et al. 2006). Chinook salmon spawning is not known to occur in the LDW or in the streams flowing into the estuary and lower reaches of the waterway (Weitkamp and Ruggerone 2000).

3.2 Puget Sound Steelhead

The Puget Sound Distinct Population Segment (DPS) of steelhead is listed as threatened, and includes all naturally spawned anadromous winter-run and summer-run populations in

streams in the river basins of the Strait of Juan de Fuca, Puget Sound, and Hood Canal, Washington, bounded to the west by the Elwha River (inclusive) and to the north by the Nooksack River and Dakota Creek (inclusive), as well as two winter-run steelhead hatchery stocks, the Green River and Hamma Hamma stocks.

Steelhead have the most complex life history traits of any of the anadromous salmonids. They may spend anywhere from 1 to 4 years in freshwater (typically 2 to 3 years) and migrate to saltwater for another 1 to 6 years (typically 2 to 3 years). Puget Sound steelhead are most abundant in northern Puget Sound and there are several rivers with summer and winter steelhead stocks, including the Duwamish River. Summer Duwamish River steelhead are a non-native stock that occurs in very low numbers. Winter steelhead are a native stock with some hatchery and wild production, occurring in much larger numbers.

Unlike other species of Pacific salmonids, some steelhead do not die after spawning and are capable of repeat spawning. Only a small percentage of steelhead (an average of 8 percent overall among West Coast populations [Busby et al. 1996]) return to the spawning grounds for more than 1 year. Steelhead that survive after spawning (mostly females) will out-migrate to the marine environment. These fish are capable of moving offshore in marine waters very soon after migrating from the river. Repeat spawners may return after 1 or 2 more years at sea.

Generally, juvenile steelhead would be present in or near the Action Area during their outmigration from freshwater beginning mid-March to early April through June, mostly migrating directly to the open ocean and not rearing extensively in the estuarine or coastal environments (Burgner et al. 1992). Because of their ability to spawn multiple times, adults could be present year-round.

3.3 Coastal-Puget Sound Bull Trout

The bull trout in the coterminous lower 48 states are listed as threatened under the ESA. Bull trout and Dolly Varden are the only char in the family *Salmonidae* native to Washington (King County DNR 2000a). Although bull trout and Dolly Varden appear physically similar, mitochondrial DNA analysis has determined that bull trout are actually more closely related to the white spotted char (*S. leucomaenis*) of Asia than Dolly Varden

(USFWS 2004a). Bull trout can be identified in the field by readily apparent characteristics such as fin rays, gill rakers, body size, body shape, and life history. For example, bull trout are distinguished from Dolly Varden by their generally larger size, longer, broader head and the fact that their maxilla (upper jaw bone) extends significantly farther behind the eye than that of the Dolly Varden, which often just reaches the eye (Fish 2004).

In Puget Sound, there are 15 subpopulations of native char, which include both bull trout and Dolly Varden (King County DNR 2000a). In King County, known populations of self-sustaining native char occur in the Skykomish, Cedar, and White River basins. Observations of native char in King County have been recorded in the lower Green River and the Duwamish estuary, among other areas, but are not common (King County DNR 2000a). These observations do not indicate a self-sustaining population of bull trout in the Green River, as these fish exhibit complex migration strategies, including a marine component that is not widely understood. Unlike anadromous Pacific salmonids, certain bull trout exhibit amphidromous migration patterns. Amphidromous individuals often return seasonally to non-natal freshwater as subadults, sometimes for several years, before returning to their natal streams to spawn (DOI 2004). For bull trout, the amphidromous life history form is limited to the Coastal-Puget Sound population (DOI 2004). These subadults are the fish expected to be using the LDW.

Bull trout have more specific habitat requirements than most other salmonids. Habitat components that influence bull trout distribution and abundance include water temperature, cover, channel form and stability, valley form, spawning and rearing substrate, and migratory corridors (USFWS 2004a). The population of bull trout occurring in the LDW and Green River is part of the Coastal Puget Sound population, and are therefore understood to have an amphidromous life history; bull trout are also iteroparous. These bull trout spawn in freshwater, and the smolts typically enter marine water at 2 years of age and around 6 inches, although much smaller individuals have been reported (DOI 2004). Subadult and adult bull trout return to overwinter in lower mainstem rivers following their first summer in saltwater, before returning to saltwater the following spring (Kraemer 1994; DOI 2004). These fish would return from August through November; therefore, some subadult amphidromous bull trout could be occupying the waters of the Duwamish River during the removal action. Mature adult amphidromous bull trout (approximately Age 4) begin

reentering natal mainstem rivers in late spring and early summer to migrate to their spawning tributaries (DOI 2004), whereas immature subadults may return to the marine waters. After amphidromous forms complete spawning, they usually return downstream to lower mainstem rivers and marine habitats (Kraemer 1994). Juveniles would out-migrate between May and early July, but given the project timing and lack of evidence of a self-sustaining population of bull trout in the Green River, juvenile bull trout would not be expected to occur in the project area during construction.

3.4 Other Species

Other species initially considered in this consultation include eulachon (*Thaleichthys pacificus*), bocaccio (*Sebastes paucispinis*), canary rockfish (*Sebastes pinniger*), Yelloweye rockfish (*Sebastes ruberrimus*), Steller sea lion (*Eumetopias jubatus*), leatherback sea turtle (*Dermochelys coriacea*), Humpback whale (*Megaptera novaeangliae*), and Southern resident killer whale (*Orcinus orca*). These species were excluded from further analysis due to their unlikely presence in the Action Area as follows:

- According to the NMFS's status report on eulachon (2010), no substantial evidence was found that spawning stocks of eulachon occur within rivers draining into Puget Sound. Additionally, NMFS concluded that although occasional occurrence has been reported, the Puget Sound area is not known to support established populations of eulachon (NMFS 2010). For these reasons, the presence of eulachon in the RAB would be very unlikely.
- The three rockfish species (bocaccio, canary, and yelloweye) are known to associate with rocky reefs, kelp canopies, and artificial structures such as piers and oil platforms. Adult rockfish are found in deeper water as they age and increase in size, exhibiting strong site fidelity to rocky bottoms and outcrops. Yelloweye rockfish occur in the shallowest water range, occurring at depths of just 80 feet, but along with bocaccio, they can be found at depths up to 1560 feet. The most common depth range among these fish is approximately 300 to 600 feet. The juvenile rockfish can be found at shallower depths, but are typically found around eelgrass beds, kelp forests, and other forms of in-water structures. The waters in the LDW are not likely to be deep enough, nor provide the type of substrate and cover (rocky outcrops and kelp/eelgrass

beds) that these fish typically associate with; therefore, it is concluded that these rockfish species would be very unlikely to be present in the RAB.

- The nearest Steller sea lion haul-out location is located off West Point just north of Elliott Bay. Based on their infrequent use of central Puget Sound and high level of human activity typical of the LDW, Steller sea lions are very unlikely to be present in the Action Area during construction.
- The leatherback sea turtle typically occurs in offshore locations and there are no documented sightings within Puget Sound; therefore, it is unlikely that this species uses Elliott Bay or the LDW.
- Humpback whales, based on their infrequent use of Puget Sound and combined unsuitable habitat and high level of human activity typical of the LDW, are considered extremely unlikely to be present in the Action Area at any time.
- The Southern Resident killer whale is known to occur in Elliott Bay, with sightings occurring several times a year; however, due to the location of the removal action (RM 3.6 of the LDW), narrow waterway conditions, and the high level of human activity typical of the LDW, it is extremely unlikely to be present in the Action Area at any time.

3.5 Critical Habitat

Critical habitat in the Action Area has been designated for the Puget Sound ESU of Chinook salmon and the Coastal-Puget Sound DPS of bull trout considered in this BA (see Table 1). The ESA defines critical habitat under Section 3(5)(A) as “the specific areas within the geographical area occupied by the species, at the time it is listed on which are found those physical or biological features that are essential to the conservation of the species and which require special management consideration or protection; and specific areas outside the geographical area occupied by the species at the time it is listed...upon determination by the Secretary that such areas are essential for the conservation of the species.”

Critical habitat for Puget Sound Chinook salmon was designated on September 2, 2005 (50 CFR Part 226). For bull trout, critical habitat was re-designated on October 18, 2010 (DOI 2010). Once critical habitat is designated, Section 7 of the ESA requires federal agencies to ensure that they do not fund, authorize, or carry out any action that will destroy or adversely modify that habitat. This requirement is in addition to the Section 7 requirement that

federal agencies ensure that their actions do not jeopardize the continued existence of listed species.

In rivers such as the Duwamish, the lateral extent of critical habitat for salmonids is defined by the ordinary high water mark (OHWM). Thus, for this project, critical habitat in the Action Area includes the aquatic areas affected by the removal action extending landward to the OHWM. The proposed offshore extent is the area that generally coincides with the maximum depth of the photic zone.

The condition of critical habitat primary constituent elements (PCEs) in the Action Area for Chinook and bull trout is currently limited by the following factors: existing steep slopes, riprap, and sheetpile wall armoring; poor riparian vegetation conditions; and lack of complex shoreline habitat.

Regarding these species, NMFS and USFWS reviews the status of critical habitat affected by the proposed action by examining the condition and trends of PCEs throughout the designated area. PCEs consist of the physical and biological features identified as essential to the conservation of the species. The salmonid ESUs and DPSs considered in this assessment share many of the same habitats though the PCEs are different. Section 5.1.2.1 describes PCEs and potential project effects on PCEs.



4 ENVIRONMENTAL BASELINE

The Action Area is situated along a developed shoreline of the LDW. The removal action lies at RM 3.6 (Photo 1), and the removal action context is an industrial area with neighboring Boeing properties to the north and south along the river. The project area and neighboring properties were constructed primarily on fill from dredged material when the river was straightened during the early to mid-twentieth century. The area has a steep, armored shoreline and is flanked by bare ground and primarily non-native and low-growing vegetation.



Photo 1

Overview of project area, looking north; shoreline armoring is visible on the bank with sparse vegetation and sheetpile is present on south.

To evaluate the environmental baseline of the project area, field visits have been conducted by Anchor QEA, LLC biologists, and state and federal information was accessed for conditions near the removal action. The assessment of potential project effects in this BA (see Section 5) is based on a set of ecological conditions in the Action Area that may affect listed salmonid and bull trout species. Sections 4.1 through 4.3 describe the environmental

baseline relative to these ecological conditions, grouped as biological, physical, and chemical conditions.

4.1 Biological Conditions

4.1.1 Vegetation

There is limited shoreline vegetation throughout the project action area. The developed shoreline and armoring extends essentially to the top of the bank, so opportunities for existing vegetation are limited (See Photo 1). Where present, vegetation along the shoreline mainly consists of invasive Himalayan blackberry (*Rubus armeniacus*) and Douglas spirea (*Spiraea douglasii*; Photos 1, 2, and 3).



Photo 2

Typical shoreline vegetation conditions, looking south along the shore.



Photo 3

Spirea growing along the shore, looking east.

4.1.2 *Non-listed Fish and Wildlife*

The project area provides habitat for non-listed fish and wildlife species, in addition to those species with federal and/or state status. WDFW has indicated that state priority wildlife species that may occur near the removal action include osprey and western pond turtle. Non-listed salmonids identified by WDFW that may occur at the project area include Coho, pink, sockeye, and fall chum salmon (WDFW 2008a).

As described in the FS (AECOM 2010), the LDW is inhabited by numerous anadromous and resident fish species. During sampling events conducted for the Remedial Investigation (RI), 53 resident and non-resident fish species were captured in the LDW. Up to 33 resident and non-resident species of fish had been recorded in the LDW in prior sampling events (Windward 2010). As summarized in the baseline ecological risk assessment (Windward 2007c), shiner surfperch, snake prickleback, Pacific sandlance, Pacific staghorn sculpin, longfin smelt, English sole, juvenile Pacific tomcod, pile perch, rock sole, surf smelt, three-spine stickleback, Pacific herring, and starry flounder were identified as abundant at the time of the sampling events, as were chinook, chum, and coho salmon. Fish abundance in the LDW is greatest in late summer to early fall and is generally lowest in winter.

4.1.3 Epibenthic Prey

Growth and survival of juvenile salmon depends largely on the availability of certain epibenthic organisms for prey (Simenstad et al. 1982). Subadult bull trout generally prey on other fish (DOI 2010). Monitoring studies evaluating juvenile salmon diets and prey items were conducted at several intertidal habitat restoration sites in the LDW (T-105, GSA Bench, and Kellogg Island, all approximately 3 miles downstream, and Turning Basin, approximately 1 mile upstream) (Cordell et al. 2001). Results of these studies indicated that dominant intertidal epibenthic invertebrates that occur in the vicinity, including harpacticoid copepods and gammarid amphipods, are important salmonid prey items, as are terrestrial insects. Because these prey organisms typically favor smaller sand/mud substrates, the Action Area would be expected to contain these organisms in finer substrate areas such as the mudflat in the intertidal zone (see Section 4.2.1). Much of the shallow water area in the Action Area, however, contains mostly riprap rock armoring and a sheetpile and abutted concrete panel wall, which would not be expected to contain an abundance of these prey organisms.

As detailed in the FS (AECOM 2010) based on sampling done for the RI (Windward 2010), the benthic invertebrate community is dominated by annelid worms, mollusks, and crustaceans. Crustaceans are the most diverse of these three groups in the LDW, including more than 250 taxa. The most abundant large epibenthic invertebrates include slender crabs, crangon shrimp, and coonstripe shrimp. Dungeness crabs are also common, although their distribution is generally limited to the portions of the LDW with higher salinity. Mollusks include various bivalves and snails. Although the vast majority of benthic invertebrate species in the LDW are typical inhabitants of estuarine environments, a few organisms more typical of freshwater environments were found. For example, one chironomid larva was collected in intertidal habitat at RM 0.6, two chironomid larvae were collected in intertidal habitat at RM 1.4, and one chironomid larva was collected in the subtidal habitat at RM 1.6 (Windward 2010). Chironomid larvae are also prey organisms for juvenile salmonids.

4.2 Physical Conditions

4.2.1 Shoreline Armoring, Substrate, Slope, and Water Depth

The shoreline of the project area is armored with rock riprap and an abutted sheetpile and concrete panel wall (Photo 3). The dominant substrate size is angular rock near the shore grading to mud and silt in the intertidal zone. As the shoreline levels out from the bank, a mudflat is exposed at low tide (Photo 3). Surface sediment percent fines adjacent to the shore were tested and found to contain less than 20 percent along the shoreline above the 0 feet MLLW elevation, ranged between 60 and 80 percent along the northwestern corner of shoreline, and ranged between 20 and 60 percent along the middle/southern portion of the shore. In general, the fines content increases with distance from the shoreline bank, indicating a lack of accretion along the mid-upper shoreline bank (Anchor and Farallon 2008).

The LDW experiences tidal action due to its connection to Elliott Bay in Puget Sound, which is approximately 3.5 miles downriver to the northwest of the project. Water depths along the shore thus range from several inches deep at low tide to several feet at high tide, at which time the water is higher and closer to the steeper portion of the bank. Elevations in the Action Area range from approximately +19 feet at the existing top of bank to approximately -14 feet MLLW at the in-water extent of project work. Shoreline slopes are approximately 1H:1V on the bank and grade down to approximately 2H:1V in the intertidal zone.

4.2.2 Large Woody Debris

Large woody debris (LWD) along riverine and estuarine shorelines contributes to juvenile salmon growth and survival by increasing habitat complexity, creating refuge habitat, and providing a substrate for primary producers (Bisson et al. 1987; Sedell et al. 1988). In the Action Area, LWD is absent due to the lack of woody debris sources and quiescent areas for it to collect in the waterway.

4.3 Chemical Conditions

4.3.1 Water Quality

Ecology's Aquatic Use Category sets criteria for the protection of spawning, rearing, and migration of salmon and trout, and other associated aquatic life. Several different aquatic use categories have been assigned to various reaches of the Duwamish/Green River. The reach of the Duwamish River from the mouth of the river at Elliott Bay to RM 11.0 is categorized for aquatic life use as a "Salmon/Trout Rearing/Migration Only" area.

The most recent Washington State Water Quality Assessment identifies locations throughout the LDW and Duwamish River that are impaired based on CWA 303(d) and 305(b) criteria (Ecology 2009). The waters in the vicinity of the RAB are listed as Category 5 waters for dissolved oxygen and fecal coliform. Downstream of the RAB, the LDW is also listed for these parameters. For dissolved oxygen (DO), King County unpublished data from station 307 (RM 4.1) show two excursions beyond the criteria out of 57 samples collected between 1998 and 2002 near the project area. For pH, King County unpublished data from station 307 (RM 4.1) show excursions beyond the pH criterion in all years between 1998 and 2001, and three excursions beyond the criterion out of four samples taken by the Muckleshoot Tribe during 1994 and 1995.

Temperatures in the mainstem Duwamish River are high as measured temperatures in the Green River during the summer have peaked between 23 and 24 degrees C at stations in the Lower and Middle Green River. The limiting factors analysis for Water Resource Inventory Area 9 (Green/Duwamish) states that in some years, this is probably of concern for adult Chinook migration up the Green River. The analysis also stated that turbidity and total suspended solids (TSS) are possible factors of decline in terms of water column impacts for the Duwamish River, but that no information on duration was available. The water in the project area is not currently listed on Ecology's water quality 303(d) list for any chemical contaminants or nutrients (Ecology 2009). A previous limiting factors analysis stated that risks to water column dwelling organisms are minimal (King County DNR 2000b).

4.3.2 Surface Sediment Quality

The sediments within the RAB have been characterized during a number of investigations, most recently by Boeing (MCS 2004), EMJ and Jorgensen Forge (Anchor and Farallon 2006), a joint effort by USACE and EPA (Herrera and USACE 2008), EPA (Windward 2007a, 2007b), and Anchor QEA, LLC (2011, to be reported in forthcoming design deliverables). The Duwamish Waterway Group—which comprises the City of Seattle, King County, the Port of Seattle, and Boeing—compiled the sediment quality information into a single database to ensure that all parties have access to and use the same data set for sediment quality evaluations. This database was used for the data summary and evaluations presented in the Final EE/CA (Anchor 2011).

Target sediment cleanup levels have not yet been established for use in the LDW Superfund Site, as these are being developed through the RI/FS process and are not expected to be finalized until the ROD is issued. For this reason, as directed by EPA, the sediment quality data within the vicinity of the Facility were compared to the SMS criteria (Chapter 173-204 Washington Administrative Code [WAC]). Evaluation of sediment quality data under the SMS is based on a tiered approach. The initial evaluation includes a comparison of existing sediment quality data with the SMS SQS and Cleanup Screening Level (CSL) numerical criteria (see Table 2-2 of the Final EE/CA). Sediments that meet the SQS criteria are anticipated to have a low likelihood of adverse effects on biological resources that primarily dwell in the sediments (that is, benthic organisms). An exceedance of the SQS numerical criteria, however, does not necessarily indicate adverse effects or toxicity, and biological testing may be used to further evaluate the potential for sediment toxicity regardless of the identified chemical concentration.

Per WAC Section 173-204, the SMS SQS and CSL criteria for organic chemicals (excluding ionizable organic compounds) are normalized to account for the total organic carbon (TOC) content of the sediments. For LDW sediments, the recommended range for TOC-normalization is 0.5 to 3 percent TOC (Michelsen 1992). Organic chemical with TOC concentrations outside this range were maintained on a dry weight basis and compared to the dry weight lowest apparent effects threshold and second lowest apparent effects threshold values (PTI 1988). Updated apparent effects thresholds have been developed and are considered useful for risk assessments by EPA, but EPA and Ecology currently do not

recognize these updates as having a regulatory basis because these values have not undergone scientific or public/stakeholder review as required by the SMS regulations.

A brief summary of these physical and chemical analytical chemistry results and the resulting potential risk to benthic organisms and fish is provided in the following subsections.

4.3.2.1 PCBs

The majority of surface sediment PCB concentrations in the dredging areas are above the total PCB SQS criterion (12 mg/kg OC). Surface sediment total PCBs concentrations were greater than two times the CSL criterion (65 mg/kg OC) in the following areas in the vicinity of the Action Area (Anchor QEA 2011):

1. A single station located approximately on the eastern federal navigation line (station SD-322-S)
2. Adjacent to and just north of the sheetpile wall along the southern shoreline of the RAB
3. Three additional scattered stations

As described in the Final EE/CA (Anchor QEA 2011), the subsurface total PCB concentrations are horizontally and vertically heterogeneous. Of the 17 stations located just east of the federal navigation channel, six stations showed no total PCB concentrations above the SQS criteria throughout the sampled depth, nine stations showed total PCB concentrations above the SQS criteria in the 0- to 2-foot interval, and two stations showed CSL exceedances in the 0- to 2-foot interval. Three of the stations showed CSL exceedances below the 0- to 2-foot interval. Farther east approaching the shoreline, stations adjacent to the sheetpile and concrete panel walls show do not show SMS exceedances below the surface 0 to 1-foot interval except from 2 to 3-feet and 3 to 3.3-feet at station SD-314A-S (greater than lowest apparent effects threshold [LAET] and SQS, respectively). Stations farther downstream within the RAB showed heterogeneous PCB concentrations at depth with bounded and unbounded SQS and CSL exceedances extending down to 4 feet below mudline. Station AJF-07 showed the deepest depth of SQS exceedance from 6 to 6.65 feet below mudline.

4.3.2.2 *Metals*

No SQS exceedances for arsenic, cadmium, copper, or silver were detected in the surface sediments. Consistent with the total PCB concentrations, a cluster of surface sediment stations in the vicinity of the sheetpile wall along the southern shoreline of the RAB showed chromium, lead, and zinc concentrations greater than two times the CSL criteria. Surface sediment lead and zinc concentrations exceeded the SQS and/or CSL criteria at two other stations farther downstream. All of the metal SMS exceedances were limited to the nearshore area at elevations above -1 foot MLLW. Subsurface exceedances of the SQS criteria were limited and only identified at station AJF-07 from 3 to 4 feet and 6 to 6.65 feet below mudline for arsenic, station SD-311-S and SD-312-S from 1 to 2 feet below mudline for lead, and station AJF-12 from 2 to 3 feet and station SD-312-S from 1 to 2 feet for zinc.

4.3.2.3 *Semivolatile Organic Compounds*

The majority of the surface sediment sampling stations in the potential dredging/backfill areas exhibited semivolatile organic compound (SVOC) concentrations below the SQS criteria. SVOC analytes detected in surface samples above the SMS SQS criterion includes the following:

- Butylbenzylphthalate
- Dibenzofuran
- Fluorene
- Phenanthrene

Phenol exceedances of the SMS SQS criteria were also identified. The SMS SQS exceedance factors (identified concentration divided by the applicable SQS criteria) for the SVOCs and phenols were generally low, ranging from 1 to 3. No CSL exceedances were identified.

A single subsurface sediment sample was collected and sampled for non-PCB and metal chemicals within the RAB. No SMS exceedances were identified in this sample.

Similar to the metals exceedances, all of the SVOC SMS exceedances were limited to the nearshore area at elevations above -1 foot MLLW.

4.3.2.4 *Summary of Potential Risks to Benthic Organisms and Fish*

Potential risk to benthic organisms located within the RAB was evaluated in the Final EE/CA (Anchor QEA 2011) through comparison of surface (0 to 10 centimeters) sediment data with the SMS SQS. The SMS is considered protective of benthic organisms and are based on the results of sediment toxicity tests and benthic infaunal analyses. Under the provisions of the SMS, when no detailed bioassay data are available, surface sediments are categorized in one of three ways:

1. Sediments with chemical concentrations equal to or less than SQS are designated as having no adverse effects on biological resources (WAC 173-204-301[1][a]).
2. Sediments with chemical concentrations above the SQS but are equal to or less than the CSL have potential for adverse effects on biological resources.
3. Sediments with chemical concentrations above the CSL have a greater potential for adverse effects on biological resources requiring evaluation of cleanup alternatives.

The SMS SQS and CSL criteria are summarized in the Final EE/CA, Table 2-2 (Anchor QEA 2011). Within the RAB, PCB concentrations in surface sediment exceed the SQS and CSL criteria in 51 and 14 samples, respectively, out of 76 samples. As described in the previous subsections, surface sediment SMS exceedances were most often limited to PCBs, with several samples having concentrations greater than two times their respective CSL, suggesting a greater potential for adverse effects on biological resources. All other non-PCB chemical exceedances of the SMS criteria were co-located with PCB exceedances. PCB concentrations within the proposed RAB indicate that these sediments may pose a risk to benthic organisms if no action is taken.

Potential risks to fish were also evaluated in the Final EE/CA (Anchor QEA 2011) in the context of the LDW, as fish could be exposed to chemicals in sediment throughout the LDW, including the RAB. Conservative evaluations of risk from sediment to fish species that may reside or forage in the LDW were conducted as part of the Baseline Ecological Risk Assessment (BERA) for the LDW Final RI (Windward 2010). The BERA evaluated risks to representative fish species from exposure to chemicals in LDW sediments including English sole and Pacific staghorn sculpin. Wild juvenile Chinook salmon were also evaluated

because of their listing status and complete exposure pathways in the LDW during outmigration (Windward 2010).

In the BERA, exposure to chemicals of interest by fish was characterized based either on chemical concentrations in fish tissue or on chemical concentrations in likely fish prey. Overall, ecological risks to fish were relatively low for the LDW.

4.4 Summary of Existing Conditions in the Action Area

In summary, habitat in the vicinity of the Action Area currently exhibits degraded conditions in many of the characteristics discussed in previous sections. The shoreline of the Action Area contains structures and lacks the vegetation typical of the surrounding area of the Duwamish River. The sediments are degraded and require remediation. Moreover, the context of the entire Action Area within the larger landscape is a developed zone with a long history and legacy of human activities.

5 EFFECTS OF THE PROPOSED ACTION AND EFFECTS DETERMINATIONS

Sections 3 and 4 of this document defined the biological requirements of listed species and the environmental baseline of habitat in the Action Area. This section addresses direct, indirect, and interrelated/interdependent effects of the proposed action on listed species and designated critical habitat within the Action Area. Potential direct effects are those effects that occur at or very close to the time of the action. Indirect effects are those that are caused by the proposed action and occur later in time, but still are reasonably certain to occur. Interrelated effects are those that are associated with a larger action and depend on the larger action for their justification. Interdependent effects are those with no independent utility apart from the proposed action.

The overall goal of the project is to improve sediment quality in the Action Area and reduce long-term risk to aquatic species. Although some individual organisms may experience short-term adverse effects during construction, the proposed action will provide long-term benefits for listed species and their habitat by removing contamination from within the RAB.

5.1 Potential Project Effects

5.1.1 *Potential Direct and Indirect Effects*

Potential direct and indirect effects on Pacific salmonids and bull trout assessed for this proposed action include those resulting from disturbance to food sources, entrainment, water quality impacts, and alteration of nearshore habitat.

5.1.1.1 *Food Source Disturbance*

As previously indicated, juvenile salmon diets in the Action Area are tied to epibenthic prey organisms occurring in shallow water areas. In-water work for this removal action will temporarily disturb existing epibenthic organisms and habitat in the dredging area and in areas where shoreline in-water work is to be completed (for example, shoreline excavation and containment, piling and outfall removal). As described in Section 4 of this BA, the substrate along the shore is highly modified and exhibits an abundance of armoring, resulting in less area for production of epibenthic prey on bottom substrates in these shallow water locations. Although disturbances to benthic habitat will occur during removal action activities it is expected that—due to existing compromised habitat for prey species and the

context of the work area within an already disturbed landscape—impacts to juvenile salmon via disturbance of the epibenthic prey community will be minimal and short-term. The benthic community is expected to recover within a year with species from nearby areas moving into the disturbed area to re-colonize. Moreover, the overall purpose of conducting the removal of sediment contamination in the Action Area is to reduce exposure to existing contaminants and to provide long-term benefits to prey species, as well as salmon and bull trout, by significantly improving overall benthic habitat conditions. Adult salmon are typically not feeding during migration, so their food source is limited to the off-shore marine area and would not be impacted through implementation of the proposed removal action.

Subadult bull trout that may be in the Action Area could be feeding. Their food source is primarily other fish, and therefore their food source could be temporarily impacted by the construction of the proposed action if fish are driven away from the Action Area; however, they would be able to follow the prey to other areas outside of the construction zone. As such, the impacts of construction of the proposed action on food sources for bull trout are expected to be discountable. Again, the overall purpose of conducting the removal action is to improve sediment quality and provide long-term benefits to prey species by improving benthic habitat conditions.

5.1.1.2 *Entrainment*

Juvenile salmon and subadult bull trout could be entrained in dredging equipment during dredging operations, however, this potential impact is expected to be discountable. Due to work timing restrictions, very small numbers of juvenile salmon and even fewer numbers of subadult bull trout are likely to be present in the dredge area. Pressure waves created as the bucket descends through the water column will forewarn salmon and bull trout present within the area and will allow individuals time to avoid the equipment. In addition, for mechanical dredging, the clamshell jaws will be open during descent, which should reduce the likelihood of entrapping or containing fish (NMFS 2003). The USACE conducted extensive dredge entrainment monitoring within the Columbia River in 1985 through 1988 (Larson and Moehl 1990). In the study, no juvenile salmon were entrained due to mechanical dredging. McGraw and Armstrong (1990) examined fish entrainment rates due to mechanical dredging outside of peak migration times in Grays Harbor from 1978 to 1989 and found that one juvenile salmon was entrained. Based on this information, impacts to

juvenile salmon from entrainment are expected to be discountable. Subadult bull trout are expected to be able to swim around the active dredge areas and would be impacted less than juvenile salmon.

5.1.1.3 Water Quality

Potential short-term water quality impacts may occur as a result of shoreline excavation and containment, and dredging and backfill activities. Conservation measures (Section 2.3) and water quality monitoring will be implemented during these activities. The project team will be in active communication with EPA to ensure close coordination in the event of an exceedance. Despite the potential for short-term water quality impacts to occur, the purpose of the removal action is to improve long-term sediment quality through remediation. The remediation of the sediment within the RAB will result in substantial decreases in, or removal of, exposure pathways to COCs in bulk sediment, sediment porewater, and surface water.

The following actions will be conducted that will minimize short-term water quality effects on fish:

- All dredged sediments will be removed to an upland disposal location and any new cover will be clean, which will have the long-term effect of sustaining a healthier invertebrate community and improve foraging opportunities for salmonids.
- Dredging activities in the intertidal sediment and shoreline bank soil excavation areas will be conducted in-the-dry to the degree reasonably possible using land-based equipment. Intertidal sediment and shoreline bank soil excavation in-the-dry reduces the potential for release of impacted intertidal sediment and shoreline bank soils to the waterway by removing the sediment accessible from the upland when the tides are out and the sediment is exposed. The work is best done during daylight hours during very low tides, which occur only during May through August of each year. Alternatively, low tides during the in-water construction window occur during night hours, although EPA is currently limiting all cleanup activities to occur from 7 a.m. to 6 p.m., with possible extension to 9 p.m. for consistency with the City of Tukwila noise ordinance.

- Water quality in the Action Area will be monitored during removal action activities according to the WQC, and additional actions will be taken to reduce short-term water quality impacts, if unacceptable water quality is observed (see Section 2.3). According to WAC Section 173-201A-400, mixing zones may be authorized by the State to allow for temporary exceedances of state water quality criteria on a short-term basis immediately adjacent to a permitted project. During development of the WQC, the mixing zone will be determined that will extend a determined number of feet radially from the general construction area. The mixing zone will consider a reasonably sufficient distance to allow for temporary water quality exceedances to occur and resolve. Areas outside of the mixing zone must be in compliance with the criteria defined in the WQC. It is expected that the mixing zone for this project will extend 300 feet radially from the work area.

Specific water quality impacts and potential effects are discussed in detail in the following subsections.

5.1.1.3.1 Dissolved Oxygen

During dredging, suspension of anoxic sediment compounds may result in reduced DO in the water column as the sediments oxidize, but any reduction in DO beyond background is expected to be limited in extent and temporary in nature. Based on a review of four studies on the effects of dredging on DO levels, LaSalle (1988) showed little or no measurable reduction in DO around dredging operations². In addition, impacts to listed fishes due to any potential DO depletion around dredging activities are expected to be minimal for several reasons:

1. The relatively low levels of suspended material generated by dredging operations
2. Counterbalancing factors in the area, such as tidal or current flushing
3. DO depletion typically occurs low in the water column
4. High sediment biological oxygen demand created by suspended sediment in the water column is not common (LaSalle 1988; Simenstad 1988)

² Bucket dredge operation in channel in New York; cutterhead dredge operation in Grays Harbor, Washington; hopper dredge operation in Oregon tidal slough; bucket dredging operation in widened portion of lower Hudson River, New York.

During backfill, material placed is not expected to result in a change in sediment oxygen demand (and resulting DO reduction) during transport through the water column. There may be minor resuspension at the point of impact of the placed materials; however, this condition is expected to be temporary and localized, and the activity will be monitored by water quality testing. Based on the previous information, during dredging and material placement, DO is not expected to drop to a level that will detrimentally impact salmonids that may occur in the area.

Effects to listed salmon and bull trout from reduced DO include the following; however, these effects are not expected to occur, based on the information provided:

- Reduced concentrations of DO can negatively affect the swimming performance of migrating salmonids (Bjornn and Reiser 1991). The upstream migration by adult salmonids requires swimming over long distances, which requires high expenditures of energy and therefore adequate levels of DO (Carter 2005).
- Juvenile salmonids are strong active swimmers requiring highly oxygenated waters (Spence 1996, as cited in Carter 2005). Salmonids may be able to survive when DO concentrations are low (<5 milligrams per liter [mg/L]), but growth, food conversion efficiency, and swimming performance will be adversely affected (Bjornn and Reiser 1991). Davis (1975, as cited in Carter 2005) reviewed numerous studies and reported no impairment to rearing salmonids if DO concentrations averaged 9 mg/L, while at oxygen levels of 6.5 mg/L, "the average member of the community will exhibit symptoms of oxygen distress," and at 4 mg/L a large portion of salmonids may be affected (Carter 2005). In a review of constant oxygen exposure studies, Ecology (2002, as cited in Carter 2005) concluded that salmonid growth rates decreased less than 10 percent at DO concentrations of 8 mg/L or more, less than 20 percent at 7 mg/L, and generally less than 22 percent at 5 to 6 mg/L. Herrmann (1958, as cited in Carter 2005) found that the mean percentage of weight gain in juvenile coho held at constant DO concentrations was 7.2 percent around 2 mg/L, 33.6 percent at 3 mg/L, 55.8 percent near 4 mg/L, and 67.9 percent at or near 5 mg/L.
- Salmonids have been reported to actively avoid areas with low DO concentrations, which is likely a useful protective mechanism that enhances survival (Davis 1975, as cited in Carter 2005). Field and laboratory studies have found that avoidance

reactions in juvenile salmonids consistently occur at concentrations of 5 mg/L and lower, and there is some indication that avoidance is triggered at concentrations as high as 6 mg/L (Carter 2005).

- Salmonid mortality begins to occur when DO concentrations are below 3 mg/L for periods longer than 3.5 days (EPA 1986, as cited in Carter 2005). A summary of various field study results by Ecology (2002, as cited in Carter 2005) reports that significant mortality occurs in natural waters when DO concentrations fluctuate in the range of 2.5 to 3 mg/L. Long-term (20 to 30 days) constant exposure to mean DO concentrations below 3 to 3.3 mg/L is likely to result in 50 percent mortality of juvenile salmonids (Ecology 2002, as cited in Carter 2005).

5.1.1.3.2 Exposure to Contaminants

The primary goal of the proposed action is to reduce the potential exposure of aquatic organisms to chemical contaminants in the sediments. As such, physical disruption of the contaminated sediments during dredging is necessary. The dredging action, mainly in subtidal areas and potentially in intertidal and bank areas (if not dredged in-the-dry), could potentially cause a short-term increase in concentration of some chemicals in the water column in the immediate vicinity of the dredging because of resuspension of sediment or desorption of the contaminants from the sediment particles. If present in the water near the dredge action, salmon and bull trout could experience exposure to increased concentrations of chemical contaminants in a localized area for a short amount of time.

Based on the results of sediment sampling within the RAB, the potential acute exposure of contaminants during dredging in the Action Area could include PCBs, metals (chromium, lead, zinc, and arsenic), and polycyclic aromatic hydrocarbons (PAHs). Acute thresholds are used for dredging because dredging activities are generally intermittent throughout a day and do not occur continuously. Potential effects to listed salmon and bull trout from exposure to these three chemical groups are summarized as follows:

- **PCBs:** Due to their low water solubilities, PCBs predominantly partition with the sediment and suspended particulate phases in aquatic environments. Remedial dredging may temporarily disturb sediments, resuspending PCB contaminated particulate and releasing porewater with PCBs into surface water. While some of the disturbed sediments may release PCBs potentially bioavailable to juvenile salmon and

bull trout, observations made during other field studies have indicated that PCB releases were small in comparison to the effective dilution of the receiving system (Anchor Environmental 2003). The studies found that the concentration of PCBs in the water column tended to be minimal and were often below detection limits (Anchor Environmental 2003). Therefore, it is unlikely that the aqueous concentrations produced during dredging would be lethally toxic to fish in the dredging area (Anchor Environmental 2003).

Fish species exhibit different sensitivities to acute aqueous PCB exposure. Acute exposure studies suggest that salmonids are not especially sensitive to a mortality endpoint. PCBs are generally not readily metabolized by teleosts (White et al. 1997), and therefore, tend to bioaccumulate in exposed fish. While fish may accumulate high PCB levels, the concentrations alone may not be predictive of adverse effects (Eisler and Belisle 1996; Anchor Environmental, 2003). Some organisms are capable of storing extremely high PCB concentrations in their fat without apparent detrimental effect (Anchor Environmental 2003). When fat stores are used for energy, mobilized PCBs may cause adverse effects (Anchor Environmental, 2003). Sublethal effects may include decreased growth, reproductive toxicity, immunotoxicity, neurotoxicity, hormone level modulation including decreased thyroxin levels (which may potentially affect metabolism), and altered enzyme activity (summarized in Eisler 1986; Eisler and Bisele 1996; Meador et al. 2002).

Planar PCB mechanism of toxicity may differ from that of non-planar PCB. Through binding to the aryl-hydrocarbon receptor, planar PCBs may elicit dioxin-like effects, including immunodeficiency, hepatotoxicity, and wasting syndrome (summarized in Suedel et al. 1997). Aqueous-specific exposure studies have reported a range of sublethal effects in teleost species. Due to processes of dilution during remedial dredging, the intermittent nature of dredging, and the migratory behavior of the fish, juvenile salmon and subadult bull trout are not likely to be exposed to chronic high PCB concentrations in the dredge area. In addition, due to work timing restrictions, very small numbers of juvenile salmon and even fewer numbers of subadult bull trout are likely to be present if PCBs are resuspended in the water column at concentrations that cause biological effects during dredging.

- **Metals:** Desorption of metals from suspended sediments are a potential concern during dredging. Different studies have shown that metal concentrations in interstitial (pore) water are correlated with observed biological effects (Ankley et al. 1996, as cited in Anchor Environmental 2003). However, based on laboratory results and field observations (Brannon et al. 1976, Lee et al. 1975, Wright 1978, Hirst and Aston 1983; EVA 1997 all as cited in Anchor Environmental 2003), many studies have concluded that during dredging, releases of dissolved metals from the sediments, even in highly contaminated areas, were minimal. Even though release of total metals can be large, concentrations of dissolved metals are, in general, low and occur for a short duration (CEM 1983, as cited in Anchor Environmental 2003). As such and due to work timing restrictions, very small numbers of juvenile salmon and even smaller numbers of subadult bull trout are likely to be present if metals are resuspended in the water column at concentrations that cause biological effects during dredging. In addition, a key BMP that will be implemented during dredging is that intertidal and shoreline bank areas will be dredged in-the-dry to the extent practicable to minimize the potential for contaminant resuspension. All of the metals exceedances occur in intertidal areas.
- **PAHs/SVOCs:** Studies of organic contaminant releases to the water column during dredging have been conducted in the past (Ludwig and Sherrard 1988, Brannon 1978, Thomann and Connolly 1984, Thomann 1989, Hydroqual 1994; all as cited in Anchor Environmental 2003). Theoretically, the equilibrium exchange can allow for release during the dredging of impacted sediments, and the concentrations of soluble, available organic compounds in water could therefore increase above ambient levels. However, observations made during field studies indicated that the releases were small in comparison to the effective dilution of the receiving system, and any changes in the water quality were transient, even when grossly contaminated sediments were dredged (Ludwing and Sherrard 1988; Brannon 1978, both as cited in Anchor Environmental 2003).

Similar results have been observed for PAHs measured during dredging projects. Monitoring conducted at the ports of Los Angeles (Berths 167-169, 148-151, 261-265, and 212-215) and Long Beach (Pier T) show PAH concentrations in the water column

that are a fraction of that observed in the sediments (MBC 2001a, 2001b, 2001c, 2001d, 2001e, and 2001f; all as cited in Anchor Environmental 2003). For example, dredge monitoring at Port of Los Angeles Berths 261-265 showed PAH concentrations that were 4 to 6 orders of magnitude lower than the concentrations measured in the sediments. In sediment core samples, total PAH concentrations ranged from 9 to 52 parts per million (ppm), while water column concentrations ranged from 0.098 to 1.5 parts per billion (ppb) (MBC 2001e, as cited in Anchor Environmental 2003).

Similar to PCBs, PAHs can cause both lethal and sublethal effects to salmonids depending on the bioavailable levels of the contaminants in the resuspended particles and the water column. Sublethal effects include immune suppression (which increases disease-related mortality), hormone disruption, and disrupted reproduction (Arkoosh et al. 1998). PAHs are metabolized and detoxified in salmonids and, therefore, are not bioaccumulated (Varanasi et al. 1989, as cited in NMFS 2008).

Based on the information provided and due to work timing restrictions, very small numbers of juvenile salmon and even smaller numbers of subadult bull trout are likely to be present if PAHs/SVOCs are resuspended in the water column at concentrations that cause biological effects during dredging. In addition, a key BMP that will be implemented during dredging is that intertidal and shoreline bank areas will be dredged in-the-dry to the extent practicable to minimize the potential for contaminant resuspension. All of the PAH/SVOC exceedances occur in intertidal areas.

The extent of any potential exposures related to dredging is expected to be consistent with the mixing zone provided in the WQC, which is expected to extend 300 feet radially from the work area. The duration for the potential for exposure related to dredging is intermittently over approximately 4.5 weeks of the in-water work window during construction. The potential for exposure to occur related to dredging is not constant, but rather intermittent as the dredging activity is not expected to occur constantly over the 3.5 week period or constantly during each day. Dredging can occur from 7 a.m. to 6 p.m., with possible extension to 9 p.m. for consistency with the City of Tukwila noise ordinance; however, dredging is expected to be intermittent throughout the day. Each day there will be

at least a 10 to 13 hour period where no dredging will occur. Moreover, the in-water work window is set for the time when very few juvenile salmon and even fewer subadult bull trout are expected to be in the vicinity. Furthermore, the length of time that sediments are resuspended plays a critical role in determining the chemical impacts to the water column (Tomson et al. 2003, as cited in Anchor Environmental 2003) for dissolved phases. It has been shown that the vast majority of resuspended sediment settles close to the dredge within 1 hour and only a small fraction takes longer to resettle (Wright 1978, Van Oostrum and Vroege 1994, Grimwood 1983; all as cited in Anchor Environmental 2003). Therefore, it is expected that for this proposed action, a majority of the resuspended sediments would settle in the vicinity of the dredging activity and that an inconsequential amount would travel downstream to other areas of the LDW.

Overall, the duration of the project and the timing of in-water work to coincide with the in-water work window suggest a low chance of listed fish experiencing exposure to sediment contaminants and an even lower chance of fish experiencing harmful exposure. In addition, following dredging, the concentration of the surface left after dredging and backfilling with imported material will be lower than the existing surface, thereby reducing existing exposure levels to aquatic organisms over the long term.

There is also a small chance that fish could also be exposed to contaminants because of accidental spills from construction equipment; however, spills and accidental releases of dredged material during handling will be minimized and mitigated by implementing standard and appropriate material handling and containment procedures as described in Section 2.2.

5.1.1.3.3 Turbidity

Dredging may cause water quality exceedances for turbidity under certain situations. There may be temporary increases in turbidity due to activities associated with the proposed action, especially dredging and excavation; however, increased turbidity is expected to be short-term and localized and is not expected to result in any long-term effects. As stated previously, during development of the WQC, a mixing zone will be determined that will extend a determined number of feet radially from the general construction area. The mixing zone will be determined in accordance with WAC 173-201A-400 and will consider a

reasonably sufficient distance to allow for temporary water quality exceedances to occur and resolve). It is expected that temporary water quality exceedances, mainly turbidity, will resolve back to compliance conditions (i.e., 10 Nephelometric Turbidity Units [NTUs] above background for background turbidity levels less than 50 NTU or 20 percent of background levels for background levels greater than 50 NTUs) within the mixing zone that will be determined during development of the WQC. It is expected that the mixing zone will extend 300 feet radially from the work area. Areas outside of the mixing zone must be in compliance with the turbidity criterion.

The mechanisms by which mechanical clamshell dredging causes increased suspended sediment concentrations and turbidity levels include the impact and withdrawal of the bucket from the substrate, the washing of material out of the bucket as it moves through the water column, and the loss of water as the sediment is loaded onto the barge (Hayes et al. 1984; Nightingale and Simenstad 2001). The duration of the highest turbidity exposure is expected to be hours because construction operations are not likely to occur on a continuous, 24-hour-a-day, 7-day-a-week schedule. For this reason, the most turbid conditions will be reduced during times of no construction activity and will increase again during the next construction period. This turbidity pattern will be sustained intermittently over a period of 4.5 weeks of the in-water work window during dredging and in-water activities. Dredging will not occur constantly over the 4.5 week period or constantly during each day. Dredging can occur from 7 a.m. to 6 p.m., with possible extension to 9 p.m. for consistency with the City of Tukwila noise ordinance; however, dredging is expected to be intermittent throughout the day. Each day there will be at least a 10 to 13 hour period where no dredging will occur. As an impact minimization measure, an enclosed environmental type bucket will be used to the extent possible to limit sediment loss and resuspension during dredging activities; however, for certain conditions (e.g., large pieces of debris are present; hard substrates; piling removal) an enclosed bucket may not work properly so an alternative bucket type (e.g., digging clamshell bucket) may be necessary.

Research has shown that turbidity increases due to mechanical dredging are typically short-term and localized in nature and are close to the bottom of the water column. Suspended sediment concentrations vary throughout the water column, with larger plumes typically occurring at the bottom closer to the point of dredging. Typical surface water samples

collected adjacent to dredge locations (within approximately 150 feet), however, contain suspended sediment concentrations between 50 and 150 mg/L (Palermo et al. 1990; Havis 1988; Salo et al. 1979). Based on an evaluation of seven clamshell dredge operations, LaSalle (1988) determined that suspended sediment levels of less than 700 mg/L at the surface and less than 1,100 mg/L at the bottom would represent the upper limit concentration expected adjacent to the dredge source (within approximately 300 feet). Concentrations of this magnitude could occur at locations with fine silt or clay substrates. Much lower concentrations (50 to 150 mg/L at 150 feet) are expected at locations with coarser sediment. Even without suspended sediment controls, plume size decreases exponentially with movement away from the point of dredging, both vertically and horizontally. In addition, increases in turbidity that result from dredging activities are typically of much less magnitude than increases caused by natural storm events (Nightingale and Simenstad 2001).

For backfill, material placement is not expected to result in a significant increase in turbidity during transport through the water column due to the low fines content inherent in the clean sandy/gravel material proposed for use as backfill. There may be minor turbidity increases in the water column near the point of placement; however, this condition is expected to be temporary and localized, and the activity will be monitored by water quality testing. Regardless, during dredging/excavation, material placement, and piling removal activities, turbidity is not expected to elevate to a level that will lethally or sublethally impact salmonids or bull trout that may occur in the area. However, avoidance behavior, especially in juveniles, may occur at levels associated with dredging mainly in areas close to the dredge.

Generalized turbidity effects on fish depend on the amount and timing of exposure (NMFS 2004). Because salmonids and bull trout have evolved in systems that periodically experience short-term pulses of high suspended sediment, they are adapted to such exposures. For this reason, adult and larger juvenile fish and subadult fish may be little affected by the high concentrations of suspended sediments that occur during storm and snowmelt runoff episodes (Bjorn and Reiser 1991), although these events can produce behavioral effects, such as gill flaring and feeding changes (Berg and Northcote 1985). Some studies have shown that in waters with periodic turbidity equivalent to 23 NTUs, predation on salmonids may be

reduced (Gregory 1993; Gregory and Levings 1998), an effect that may improve overall survival.

The potential effects of increased turbidity on salmonids with regard to dredging activities have been investigated in a number of studies (Servizi and Martens 1987, 1992; Emmett et al. 1988; Simenstad 1988; Redding et al. 1987; Berg and Northcote 1985; Noggle 1978; Mortensen et al. 1976). There are several mechanisms of effect for suspended sediment levels during dredging, including direct mortality, gill tissue damage, physiological stress, and behavioral changes. Each of these potential effects with respect to dredging (activity expected to cause the largest increases in turbidity) is discussed in the following subsections. It is anticipated that due to the similarities in physiology, the potential effects described as follows would be similar for bull trout; however, it is expected that subadult bull trout would be able to move to avoid a turbidity plume more than juvenile salmon.

5.1.1.3.4 Direct Mortality

Direct mortality from extremely high levels of suspended sediment has been documented at concentrations far exceeding those caused by typical dredging operations (700 to 1,100 mg/L for fine substrates and 50 to 150 mg/L for sand and gravel substrate types). Laboratory studies have consistently found that the 96-hour median lethal concentration (LC₅₀) for juvenile salmonids occurs at levels above 6,000 mg/L (Stober et al. 1981; Salo et al. 1980; LeGore and DesVoigne 1973). Because direct mortality occurs at turbidity levels that far exceed typical dredging operations, direct mortality from suspended sediment is not expected to occur during this removal action.

5.1.1.3.5 Gill Tissue Damage

Gill tissue damage is a potential physiological impact from elevated turbidity levels. Fish gills are delicate and sensitive to silt particles. As silt enters the gills, fish excessively open and close their gills to get rid of the silt. If irritation continues, mucus is produced to protect the gill surface, which may impede the circulation of water over gills and interfere with fish respiration (Berg 1982, as cited in Bash et al. 2001).

Studies indicate that suspended sediment concentrations occurring near dredging activity are generally not high enough to cause gill damage in salmonids. Servizi and Martens (1992) found that gill damage was absent in underyearling coho salmon exposed to concentrations of suspended sediments lower than 3,143 mg/L. Redding and others (1987) also found that the appearance of gill tissue was similar for control fish and those exposed to high, medium, and low concentrations of suspended topsoil, ash, and clay. Based on the results of these studies, juvenile salmon and subadult bull trout, if present, are not expected to experience gill tissue damage even if exposed to the upper limit of suspended sediment concentrations expected during dredging.

5.1.1.3.6 Physiological Stress

Suspended sediments have been shown to cause physical stress in salmonids, but at concentrations higher than those typically caused by dredging. Physiological stress may lead to reduced survival rates and other sublethal effects. The stress response itself may compromise the organism's immune system (increasing disease susceptibility), thereby affecting mortality rates (USFWS 1998, as cited in Bash et al. 2001). Additionally, physiological stress in fishes may decrease immunological competence, growth, and reproductive success (Bash et al. 2001). A change in blood physiology is an indicator that a fish is experiencing some level of stress. At the individual fish level, stress may affect physiological systems, reduce growth, increase disease incidence, and reduce ability to tolerate additional stressors. At the population level, the effects of stress may include reduced spawning success, increased larval mortality, reduced recruitment to succeeding life stages and overall population declines. Stress to salmonids can affect the parr-smolt transformation, resulting in impaired migratory behavior, decreased osmoregulatory competence, and reduced early marine survival (Wedemeyer and McLeay, 1981 as cited in Bash et al. 2001).

Elevated blood plasma cortisol and glucose levels are indicators of physiological stress. Subyearling coho salmon exposed to suspended sediment concentrations above 2,000 mg/L were physiologically stressed, as indicated by elevated blood plasma cortisol levels (Redding et al. 1987). Exposure to approximately 500 mg/L of suspended sediment for 2 to 8 consecutive days also caused stress but to a much lesser degree (Redding et al. 1987; Servizi and Martens 1987) than exposure to concentrations above 2,000 mg/L. At 150 to 200 mg/L of

glacial till, no significant difference in blood plasma glucose (a stress indicator) concentrations were observed.

These results indicate that upper limit suspended sediment conditions near mechanical dredging activity of fine silt or clay (700 to 1,100 mg/L) can cause stress in juveniles if exposure continues for an extended period of time. Continued exposure is unlikely, however, due to the tendency for unconfined salmonids to avoid areas with elevated suspended sediment concentrations (Salo et al. 1980) and the intermittent nature of dredging operations. It is expected that subadult bull trout would swim to avoid a turbidity plume that would cause stress and that they would not be exposed to elevated turbidity levels for an extended period of time.

5.1.1.3.7 Behavioral Effects

Impacts to feeding disruption and changes in migratory behavior are potentially caused by elevated turbidity (Servizi 1988; Marten et al. 1977). Various studies have indicated that high concentrations of suspended sediment impair salmonid foraging (Bisson and Bilby 1982; Berg and Northcote 1985). At concentrations between 2,000 and 3,000 mg/L, exposed yearling coho and steelhead did not rise to the surface to feed (Redding et al. 1987). However, yearling coho and steelhead exposed to lower levels ranging from 400 to 600 mg/L actively fed at the surface. In these instances, the thresholds at which feeding effectiveness was impaired greatly exceeded the upper limit of expected suspended solids during dredging. Potential migratory behavioral impacts are also possible as a result of the proposed action. Whitman and Miller (1982) studied the migration impacts on returning adult salmon by heavily turbid conditions. The study found that despite persistently high concentrations of suspended sediment (7 days of concentrations of 650 mg/L), adult male Chinook could still detect natal waters through olfaction.

Sigler et al. (1984, as cited in Bash et al. 2001) conducted tests to determine the point at which juvenile steelhead and coho subjected to continuous turbidities would leave an area. Tested turbidities ranged from 57 to 265 NTUs (Bash et al. 2001). In tanks with mean turbidities of 167 NTUs or higher, no fish were found. Fish were found in tanks with lower turbidities (57 and 77 NTUs) at numbers near carrying capacity (Bash et al. 2001). A mean avoidance of 25 percent was discovered for juvenile coho exposed to a 7,000 mg/L level of

suspended sediment (Servizi and Martens 1992, as cited in Bash et al. 2001). The authors estimated that the threshold for avoidance by juvenile coho was 37 NTU. Berg (1982; as cited in Bash et al. 2001) found that juvenile coho exposed to a short-term pulse of 60 NTU left the water column and congregated at the bottom of an experimental tank. When the turbidity was reduced to 20 NTU, the fish returned to the water column (Bash et al. 2001). Although most of these studies found behavioral impacts at TSS levels well above those expected during dredge events, juvenile salmonid and subadult bull trout avoidance behavior may occur at levels associated with dredging mainly in areas close to the dredge.

Overall, a majority of the behavioral effects caused by elevated turbidity appear to impact salmonids at levels greater than those expected to result from the proposed action; however, there may be turbidity levels close to the dredge that would result in avoidance behavior.

5.1.1.4 Alteration of Nearshore Habitat

The LDW is a migratory corridor for juvenile and adult salmon as well as a rearing area for subadult bull trout, as discussed in Section 3 of this BA. Nearshore habitat in the project area used by salmon and bull trout will be affected in the short term due to dredging/excavation and material placement activities that will disturb and/or cover existing sediments.

However, no permanent loss of habitat is expected to occur in the Action Area. The proposed work will improve nearshore habitat by removing contaminants from the system and placing a clean surface substrate such that the net effect will be an improvement over existing conditions. The nearshore habitat that is being affected is impacted by chemicals and is located in an industrial area containing shoreline armoring with frequent vessel traffic, which may limit function as nearshore habitat. Moreover, a key purpose of the proposed action is to improve long-term habitat quality in the Action Area through improvements in sediment quality.

As described in Section 2, conservation measures will be taken to avoid unnecessary impacts and minimize the negative effects of this action. Specifically, most dredge areas will be backfilled to grade, except in areas near the navigation channel, to avoid converting habitat from shallow to deep water. In addition, cap armor material will be covered with a layer of habitat material to provide improved substrate conditions for benthic invertebrates and to fill in the interstitial spaces within the cap armor to remove potential hiding spaces for salmonid

predators. The overall effect of the proposed action on shoreline habitat is expected to be minimal because existing conditions in the project area are already heavily industrialized, existing and proposed substrate size is similar, and fish use of the area is currently compromised. Post-removal action conditions in nearshore habitat will provide benefits for salmon species and bull trout relative to existing conditions, and the overall effect of the action is expected to be a net benefit to listed species.

5.1.2 Effects on Critical Habitat

5.1.2.1 Primary Constituent Elements for Salmonids

The National Oceanic and Atmospheric Administration (NOAA; 2005) has identified PCEs (that is, physical and biological features) essential to the conservation of Chinook salmon. The Action Area is located at RM 3.6 of the LDW, within the Duwamish Estuary (RM 0 to 11; Green/Duwamish and Central Puget Sound Watershed Water Resource Inventory Area (WRIA) 9 Steering Committee 2005) and downstream of Chinook spawning and rearing areas (WDFW 2008b). The Action Area is therefore located in an estuarine area, and Chinook critical habitat in the Action Area will be addressed using PCEs relevant to estuarine habitat. The essential features relevant to these PCEs are provided in Tables 2 and 3, describing the life stage and activity that each PCE supports (Table 2) and the potential effects on these sites and features (Table 3).

Table 2
Sites and Essential Physical and Biological Features Designated as Primary Constituent Elements, and the Salmonid Species Life Stage Each Primary Constituent Element Supports

Site	Essential Physical and Biological Features	ESU Life Stage
Estuarine rearing	Water quantity	Juvenile growth and mobility
	Water quality and forage	Juvenile development
	Natural cover ¹	Juvenile mobility and survival
Estuarine migration	Free of artificial obstructions, water quality and quantity, and natural cover	Juvenile and adult mobility and survival

Notes:

This table is adapted from *Updated status of federally listed ESUs of West Coast salmon and steelhead* (Good et al. 2005).

- 1 Shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks (NOAA 2005).

Table 3
Potential Effects on Sites and Biological and Physical Features Designated as Primary
Constituent Elements

Site	Essential Physical and Biological Features	Effect from Proposed Action
Estuarine rearing	Water quantity	<p>No effect on water quantity or flows.</p> <p>Floodplain connectivity is already limited in the project reach by industrial activities and urbanization and will not undergo change due to the proposed removal action.</p>
	Water quality and forage	<p>Short-term effects to water quality are expected to occur related to the proposed action (particularly dredging/excavation activities), but turbidity is expected to be limited, short-term, and localized and is not expected to result in any long-term effects. Resuspension of sediments and contaminants may occur during in-water work, but salmonids would not be expected to be present or would be present in very low numbers.</p> <p>Dredging/excavation and material placement activities will temporarily disturb existing benthic organisms and habitat; however, due to existing compromised habitat (for all salmonids) and the rapid re-colonization of the impacted areas, it is expected that impacts to juvenile salmonids due to disturbance of the epibenthic prey community will be minimal. Additionally, the long-term effect will be to improve the benthic habitat by improving the sediment quality.</p> <p>Nearshore habitat is not expected to be degraded by this action. The nearshore habitat that is being affected is impacted by chemicals and is located in an industrial area, which may limit the function as nearshore habitat. Moreover, the net effect and intention of the excavation and placement of containment materials to improve the sediment quality is to provide a habitat benefit to listed species.</p> <p>Potential water quality impacts will be minimized through impact avoidance, minimization, and conservation measures as described in Section 2. For example, water quality monitoring will occur concurrent with the proposed action in accordance with the 401 WQC or equivalent issued for the removal action. In addition, in-water work for the project will comply with the timing restrictions specified in the in-water work window, when salmonids are expected to be either not present or present in very low numbers. The work window is in the fall and winter, from October 1 through February 15.</p>
Estuarine rearing	Natural cover ¹	<p>Natural cover is generally absent in the Action Area; no effect on availability of natural cover will occur as a result of the proposed action.</p>

Site	Essential Physical and Biological Features	Effect from Proposed Action
Estuarine migration	Free of artificial obstructions, water quality and quantity, and natural cover	<p>Passage will be impeded in the dredging/excavation and material placement areas during in-water work; however, the equipment is expected to only occupy a small portion of the aquatic area. As such, delays in nearshore migration are not expected to occur. Additionally, the proposed action would occur during the in-water work window when salmonids are expected to be either not present or present in very low numbers.</p> <p>See "Water quality and forage" section.</p> <p>No effect on water quantity or flows. See "Water quality and forage" section.</p> <p>See "Natural cover" section.</p>

Notes:

- 1 Shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks (NOAA 2005).

5.1.2.2 Primary Constituent Elements for Bull Trout

The Department of the Interior (DOI 2010) has identified PCEs essential to the conservation of Coastal Puget Sound bull trout. The Action Area is located within the Duwamish estuary. This area is within potential estuarine rearing areas for subadult bull trout that may come into the estuary to forage. There are no upstream spawning areas in the Green River. All nine of the PCEs identified for bull trout apply to the Action Area:

1. *Springs, seeps, groundwater sources, and subsurface water connectivity (hyporehlic flows) to contribute to water quality and quantity and provide thermal refugia.*
This project is not anticipated to have an effect on water quantity or flows, and will have a positive effect on local water quality due to the improvement of sediment quality.
2. *Migratory habitats with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.*

Passage is not expected to be impeded in the dredging/excavation or material placement areas during in-water work as the construction equipment will occupy a small portion of the aquatic area. In addition, the proposed action will occur during

the in-water work window when bull trout are expected to be present in very low numbers, if at all.

3. *An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.*

Dredging/excavation and material placement will temporarily disturb existing benthic organisms and habitat. Benthic organisms and terrestrial organisms are important prey items for juvenile bull trout; however, since there is no spawning population in the Green River system, it is expected that only subadult bull trout could be in the Action Area. Subadult bull trout feed on other fish species, which may be similarly driven to temporarily avoid the Action Area during implementation of the proposed action.

4. *Complex river, stream, lake, reservoir, and marine shoreline aquatic environments and processes with features such as large wood, side channels, pools, undercut banks and substrates, to provide a variety of depths, gradients, velocities, and structure.*

Natural cover is generally absent in the Action Area and habitat complexity is low; the proposed action is not designed to have an impact on habitat complexity.

5. *Water temperatures ranging from 2 to 15 degrees Celsius (°C; 36 to 59 degrees Fahrenheit [°F]), with adequate thermal refugia available for temperatures at the upper end of this range. Specific temperatures within this range will vary depending on bull trout life-history stage and form; geography; elevation; diurnal and seasonal variation; shade, such as that provided by riparian habitat; and local groundwater influence.*

Water temperatures in the LDW are elevated. The proposed action will not have an impact on water temperatures.

6. *Substrates of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival. A minimal amount (e.g., less than 12 percent) of fine substrate less than 0.85 mm (0.03 in.) in diameter and minimal embeddedness of these fines in larger substrates are characteristic of these conditions.*

Effects to substrate are not expected to be a significant factor in juvenile bull trout habitat quality because of the proposed action. The surface substrate to be placed in shallow water areas will comprise smaller gravel material, which is similar to the existing material in this area, and should contain a low amount of fine material. In addition, the proposed action will improve substrate quality in the long-term, which

will be a benefit to bull trout critical habitat. In addition, there is no spawning population of bull trout in the Green River system and generally, subadult bull trout are expected to use the Action Area rather than juveniles.

7. *A natural hydrograph, including peak, high, low, and base flows within historic and seasonal ranges or, if flows are controlled, they minimize departures from a natural hydrograph.*

Flows in the LDW will not be affected by the proposed action.

8. *Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.*

The proposed action is not anticipated to impact water quantity. Water quality may temporarily decline as a result of the proposed action, particularly dredging and excavation activities as described in Section 5.1.1.3. However, water quality impacts are expected to be short-term and localized, and the overall purpose of the proposed action is to improve sediment quality, which will also improve water quality in the long-term.

9. *Few or no nonnative predatory (e.g., lake trout, walleye, northern pike, smallmouth bass; inbreeding (e.g., brook trout); or competitive (e.g., brown trout) species present.*

The proposed action is not anticipated to have an impact on the number or variety of non-native species present in the Action Area.

5.1.2.3 *Habitat Conversion*

Because most dredging actions will be followed by placement of backfill material to generally return the elevations to pre-construction grade, there will be a minimal amount of habitat conversion from certain habitat types to others. Overall, there will be an increase in the amount of habitat shallower than -10 feet MLLW due to the proposed shoreline slope reconfiguration. This habitat is the most valuable to juvenile salmonids.

In general, habitat conversion will serve to increase nearshore habitat quality in the Action Area over the long term because acreage will increase in the zones where juvenile salmonids and bull trout typically migrate and feed. Overall existing habitat conditions for rearing and migration are already of low quality in the Action Area (see Section 4). Given the context of the Action Area in an industrialized reach of the LDW, although short-term habitat impacts to substrates and the benthos will occur, the long-term effect of the proposed action on

critical habitat PCEs for both salmon and bull trout is anticipated to be beneficial. Also, the project is not expected or intended to reduce the conservation value of critical habitat for salmon or bull trout. Moreover, the project will serve to increase the habitat value of the area by removing contaminated sediments from the environment, slightly reducing the shoreline slope, and placing clean surface substrates free of artificial debris.

5.1.3 Interrelated/Interdependent Effects

The remainder of the LDW Superfund Site cleanup is slated to occur in future years, with the intent and expectation of providing a net benefit to species and habitat through cleanup of contaminated sediments throughout the estuary. Particularly, the Boeing DSOA clean up action will occur in coordination with the proposed action per an MOU. The effect of these cleanup actions is expected to be beneficial to listed species affected by the proposed removal action described in this BA.

In addition, mitigation activities may occur related to other cleanup actions in order to ensure clean-up compliance with Section 404(b)(1), and restoration actions under the Natural Resource Damages Assessment process may also occur in the area. The resulting improvement of habitat quality and ecosystem function will result in a long-term benefit.

5.2 Regulatory Basis for the Effect Determination

The effect determination is the conclusion of the analysis of potential direct or indirect effects of the proposed activity on listed species and critical habitat. Regulatory guidance from the Final Section 7 Consultation Handbook (USFWS and NMFS 1998) was used to make the effects determination for the proposed activity as described in this section.

The range of conclusions that could result from the effects analysis for the effect determination includes:

- **No effect:** The appropriate conclusion when the action agency determines its proposed action will not affect listed species or critical habitat.
- **May affect, is not likely to adversely affect:** The appropriate conclusion when effects on listed species are expected to be discountable, or insignificant, or completely beneficial. Beneficial effects are contemporaneous positive effects without any

adverse effects to the species. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur. Based on best judgment, a person would not: 1) be able to meaningfully measure, detect, or evaluate insignificant effects; or 2) expect discountable effects to occur.

- **May affect, is likely to adversely affect:** The appropriate conclusion if any adverse effect to listed species may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions, and the effect is not discountable, insignificant, or beneficial (see definition of “is not likely to adversely affect” under the preceding bullet).

A key factor in making an effect determination and distinguishing between a significant and insignificant effect is determining if the effect would be significant enough to cause a take. “Take,” as defined by the ESA, includes such activities that harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct (ESA §3[19]). Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering. Harass is further defined as actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns that include, but are not limited to, breeding, feeding, or sheltering (50 CFR §17.3).

5.3 Effect Determinations

5.3.1 Effect Determination for Salmonids

As previously stated, the overall purpose of conducting the removal of sediment contamination in the Action Area is to reduce exposure to existing contaminants and to provide long-term benefits to aquatic species, including listed species and their prey, by significantly improving overall benthic habitat conditions. The following paragraphs detail the determinations for listed species.

Based on the guidance and definitions provided and the previously discussed project effects, the effect determinations for species present in the LDW is that this removal action **may**

affect, and is likely to adversely affect Puget Sound Chinook salmon and Puget Sound steelhead. Justification for the determinations is provided as follows.

Although in-water work will occur during the in-water work window when listed fish are expected to either not be present or be present in very low numbers, it is possible that individual fish could be present in the Action Area. Thus, in-water work will occur with the risk that fish could experience effects that are not discountable or insignificant.

Further, the “may affect, likely to adversely affect” determination is appropriate for these listed species that may be present for the following reasons:

- Substrate disturbance and disturbance of benthic and epibenthic prey items will occur during in-water work. This effect will be short-term and temporary due to expected rapid recovery of the benthic community following this work, and no long-term modifications of salmonid prey species habitats are expected.
- Short-term and localized impacts to water quality could result in the form of short-term changes in water column turbidity and resuspended sediment for fish and fish prey, and there is a risk of increased contaminant exposure to fish that may be in the area. Direct fish mortality from suspended sediment, however, is not expected to occur, any increase in turbidity beyond background is expected to be localized and temporary in nature, and water quality effects are not expected to be at a level that would affect the abundance of water column prey items. To reduce the risk of exposure to turbidity/suspended sediments and resuspended chemical contaminants, the proposed action would take place during the in-water work window when few juvenile salmonids are expected to be in the action area and would implement impact avoidance and minimization measures (see Section 2.1), including BMPs developed specifically to minimize sediment resuspension during construction activities. In addition, it is expected that water quality monitoring will also be required to confirm that water quality standards are being achieved during the remedial activities that disturb the sediment bottom.
- Although individual Chinook or steelhead could be impacted by the proposed action as described previously in the short-term, the impact is not expected to affect either species at the population (i.e., ESU/DPS) level and the impacts in the long-term are expected to be beneficial to the species at the individual and population level. In

general, as described previously, very small numbers of juvenile and adult populations (ESUs/DPSs) that are expected to be present during the in-water work window are expected to be within the areas of dredging or material placement. Therefore, any short-term impacts to individuals within the listed ESUs/DPSs are not expected to impact any species at the population level, and the long-term benefits of removing chemical contaminants from the sediment are expected to improve conditions for listed species survival and recovery.

The basis for this conclusion is as follows within the context of the Section 7 regulations listed in this section. Because the likelihood of the potential effects cannot be entirely discounted in the short term, their extent cannot be labeled as insignificant, and their overall benefits are not contemporaneous, a “may affect, likely to adversely affect” determination is appropriate. Effects are expected to cause habitat (and prey habitat) impacts, with a risk of impairment or disruption of normal behavioral patterns, and with a comparable risk of impact to listed fish that may be present during construction, for the reasons previously listed. However, the impact avoidance, minimization, and conservation measures previously stated and discussed in Section 2 will minimize the likelihood of take for each removal action element.

5.3.2 Effect Determination for Salmonid Critical Habitat

Based on the guidance and definitions provided and the previously-discussed project effects, the effect determination for species likely to be present at the LDW is that this proposed action **may affect but is not likely to adversely affect designated critical habitat for Puget Sound Chinook salmon**. In the event that critical habitat for Puget Sound steelhead is either proposed or designated in the future (assuming the critical habitat PCEs are similar to the Chinook), it is further concluded that this removal action would not adversely modify critical habitat (if proposed) for Puget Sound steelhead, and may affect but would not be likely to adversely affect critical habitat (if designated) for Puget Sound steelhead. Justification for these determinations is provided in this section.

The “may affect, not likely to adversely affect” determination is appropriate for these listed species that may be present for these reasons:

- In-water work will be restricted to the work window, as described previously.
- Impacts to water column habitat could result in the form of short-term changes in water column turbidity/suspended sediment and resuspended chemical contaminants for fish and fish prey; however, impacts to water column habitat are expected to be temporary and localized, and no long-term water quality effects are expected. Any increase in turbidity/suspended sediment or resuspension of chemical contaminants beyond background is expected to be localized and temporary in nature, and water quality effects are not expected to be at a level that would affect the abundance of water column prey items. To reduce the risk of exposure to turbidity/suspended sediments and resuspended chemical contaminants, the proposed action would take place during the in-water work window when few juvenile salmonids are expected to be in the action area and would implement impact avoidance and minimization measures (see Section 2.1), including BMPs developed specifically to minimize sediment resuspension, during construction activities. In addition, it is expected that water quality monitoring will also be required to confirm that water quality standards are being achieved during the remedial activities that disturb the sediment bottom.
- Temporary substrate disturbance will occur during dredging/excavation and placement of material; however, substrate disturbance effects to prey species will be short term due to expected rapid recovery of the benthic areas following disturbance, and no long-term modifications of salmonid prey species habitats are expected.
- Fish movement and migration will not be impacted by the proposed action.
- There will be no effect on water quantity or flows.
- There will be no effect on availability of natural cover.
- There will be no effect on floodplain connectivity.
- Any spills and accidental releases of dredged material during handling will be minimized and mitigated by implementing standard and appropriate material handling and containment procedures as described in Section 2.1.

The basis for this conclusion is that potential project effects may occur (“may affect”), but are not expected to result in the destruction or adverse modification of critical habitat (“not likely to adversely affect”), for the reasons previously listed. Information previously listed also shows that poor conditions for rearing and migration near the project are already significant factors for the affected species. The effects of this action will lower the value of

water quality and passage in the action area over the short term, but will not affect the conservation value of the Action Area over the long term for the ESUs with critical habitat considered here. Although short-term effects are likely, the long-term effect of the proposed action on critical habitat PCEs is expected and intended to be beneficial.

5.3.3 Effect Determination for Bull Trout

As previously stated, the overall purpose of conducting the removal of sediment contamination in the Action Area is to reduce exposure to existing contaminants and to provide long-term benefits to aquatic species by significantly improving overall benthic habitat conditions. The following paragraphs detail the determination for bull trout.

Bull trout may be present in the RAB generally as subadults during in-water work, but juvenile exposure is very unlikely given the fact that there are no bull trout populations originating from the Green River system. Given relatively similar life histories and physiology, it is anticipated that the effects of the action on subadult bull trout would be similar but to a lesser extent than those experienced by juvenile salmonids. This is because subadult bull trout are expected to swim around and avoid areas with reduced water quality or where construction is occurring. Based on the guidance and definitions provided and the previously discussed project effects, it is determined that the implementation of the proposed action **may affect, and is likely to adversely affect Coastal Puget Sound bull trout.**

Justification for this determination is provided in this section.

Bull trout are not common in the Lower Duwamish Waterway and do not originate from populations upstream of the waterway. However, subadult life stages of these fish could be present in the LDW during the in-water work period and thus, in-water work will occur with the risk that fish could experience effects that are not discountable or insignificant. Further, the "may affect, likely to adversely affect" determination is appropriate for these listed species that may be present for the following reasons:

- Substrate disturbance and disturbance of benthic and epibenthic prey items will occur during in-water work. This effect will be short-term and temporary due to expected rapid recovery of the benthic community following this work, and no long-term modifications of prey species habitats are expected. In addition, it is expected that

subadult bull trout would eat other fish as a main food source rather than benthic species.

- Short-term and localized impacts to water quality could result in the form of short-term changes in water column turbidity and resuspended sediment for fish and fish prey, and there is a risk of increased contaminant exposure to fish that may be in the area. Direct fish mortality from suspended sediment, however, is not expected to occur, any increase in turbidity beyond background is expected to be localized and temporary in nature, and water quality effects are not expected to be at a level that would affect the abundance of water column prey items. To reduce the risk of exposure to turbidity/suspended sediments and resuspended chemical contaminants, the proposed action would take place during the in-water work window when few bull trout are expected to be in the action area and would implement impact avoidance and minimization measures (see Section 2.1), including BMPs developed specifically to minimize sediment resuspension, during construction activities. In addition, it is expected that water quality monitoring will also be required to confirm that water quality standards are being achieved during the remedial activities that disturb the sediment bottom.
- Although individual subadult bull trout could be impacted by the proposed action as described above in the short-term, the impact is not expected to affect the species at the population (i.e., ESU/DPS) level and the impacts in the long-term are expected to be beneficial to the species at the individual and population level. In general, as described previously, very small numbers of juvenile and adult populations that are expected to be present during the in-water work window are expected to be within the areas of dredging or material placement. Therefore, any short-term impacts to individuals is not expected to impact bull trout at the population level, and the long-term benefits of removing chemical contaminants from the sediment are expected to improve conditions for listed species survival and recovery.

The basis for this conclusion is as follows within the context of the Section 7 regulations listed in this section. Because the likelihood of the potential effects cannot be entirely discounted in the short term, their extent cannot be labeled as insignificant, and their overall benefits are not contemporaneous, a “may affect, likely to adversely affect” determination is appropriate. Effects are expected to cause habitat (and prey habitat) impacts, with a risk of

impairment or disruption of normal behavioral patterns, and with a comparable risk of impact to listed fish that may be present during construction, for the reasons previously listed. However, the impact avoidance, minimization, and conservation measures previously stated and discussed in Section 2.1 will minimize the likelihood of take for each removal action element.

5.3.4 Effect Determination for Bull Trout Critical Habitat

Based on the guidance and definitions provided and the previously-discussed project effects, the effect determination for Coastal Puget Sound bull trout critical habitat is that this removal action **may affect, but is not likely to adversely affect designated critical habitat**. Justification for these determinations is provided in this section.

For bull trout, the RAB is within designated critical habitat. The “may affect, not likely to adversely affect” determination is appropriate for these listed species that may be present for these reasons:

- In-water work will be restricted to the work window, as described previously.
- Turbidity may have a short-term impact on the water quality PCE component related to forage and migration. It is anticipated that this will have a discountable impact of overall foraging ability within the Action Area, similar to salmonid critical habitat impacts discussed in Section 5.3.2.
- Temporary substrate disturbance will occur during dredging/excavation and material placement; however, substrate disturbance effects to prey species will be short-term due to expected rapid recovery of the benthic areas following disturbance, and no long-term modifications of prey species habitats are expected. In addition, it is expected that subadult bull trout would prey mainly on fish species rather than benthic species.
- The dredging will not create or alter any physical, chemical, or biological barriers throughout important bull trout habitat. The proposed action activities do not impact significant rearing habitat.
- There will be no known effect on floodplain connectivity and hyporehic flows.
- There will be no effect on water quantity or flows.
- There will be no effect on water temperatures.

- There will be no effect on availability of habitat complexity.
- Any spills and accidental releases of dredged material during handling will be minimized and mitigated by implementing standard and appropriate material handling and containment procedures as described in Section 2.1.

The basis for this conclusion is that potential project effects may occur (“may affect”), but are not expected to result in the destruction or adverse modification of critical habitat (“not likely to adversely affect”), for the reasons previously listed. Information previously listed also shows that poor conditions for rearing and migration near the project are already significant factors for the affected species. The effects of this action will temporarily reduce water quality and may somewhat impede passage in the action area over the short term, but will not affect the conservation value of the Action Area over the long term for bull trout. Although short-term effects are likely, the long-term effect of the proposed action on critical habitat PCEs are expected and intended to be beneficial.

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FIGURES

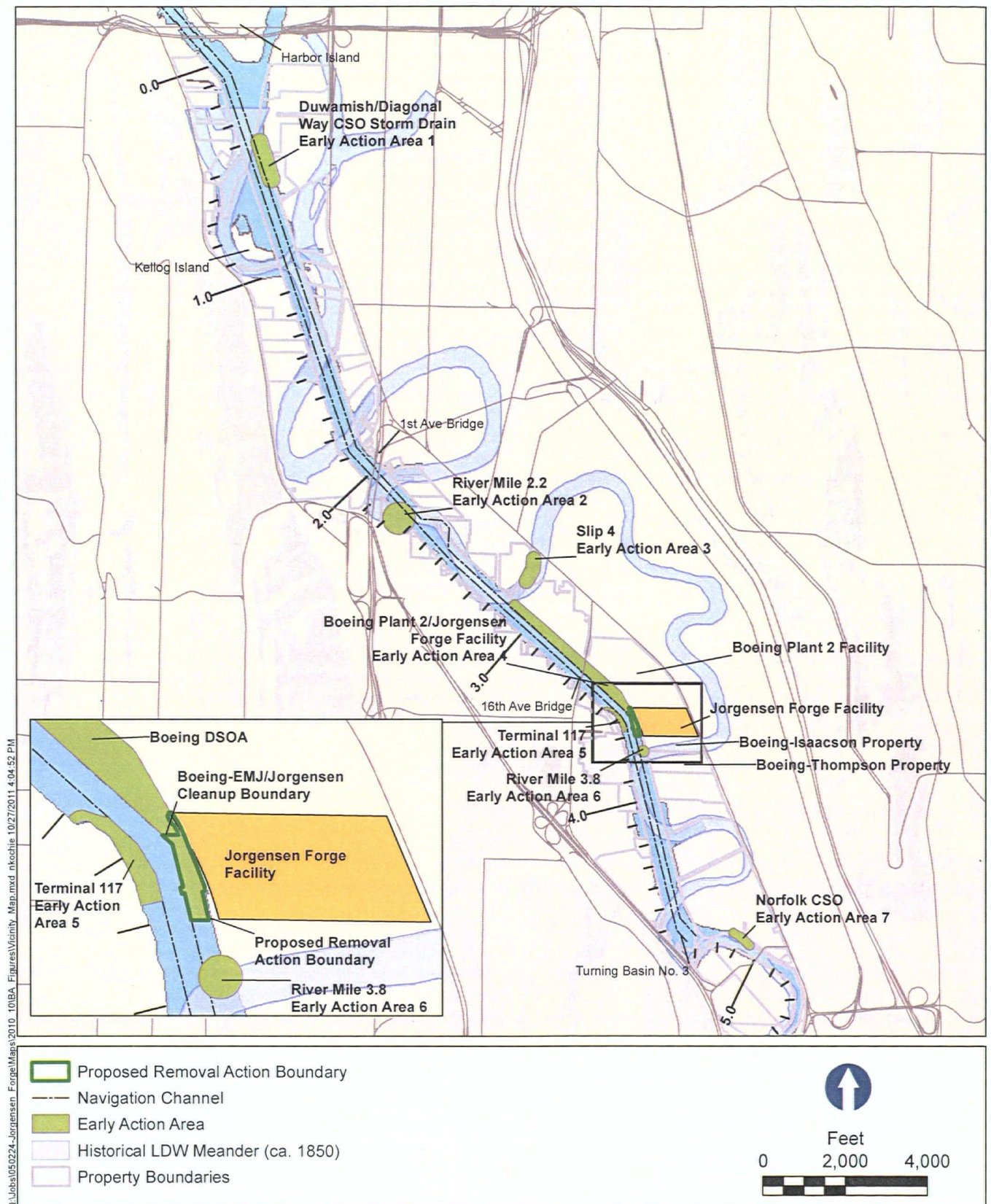


Figure 1
 Facility Vicinity Map
 Early Action Area 4 BA
 Jorgensen Forge Facility

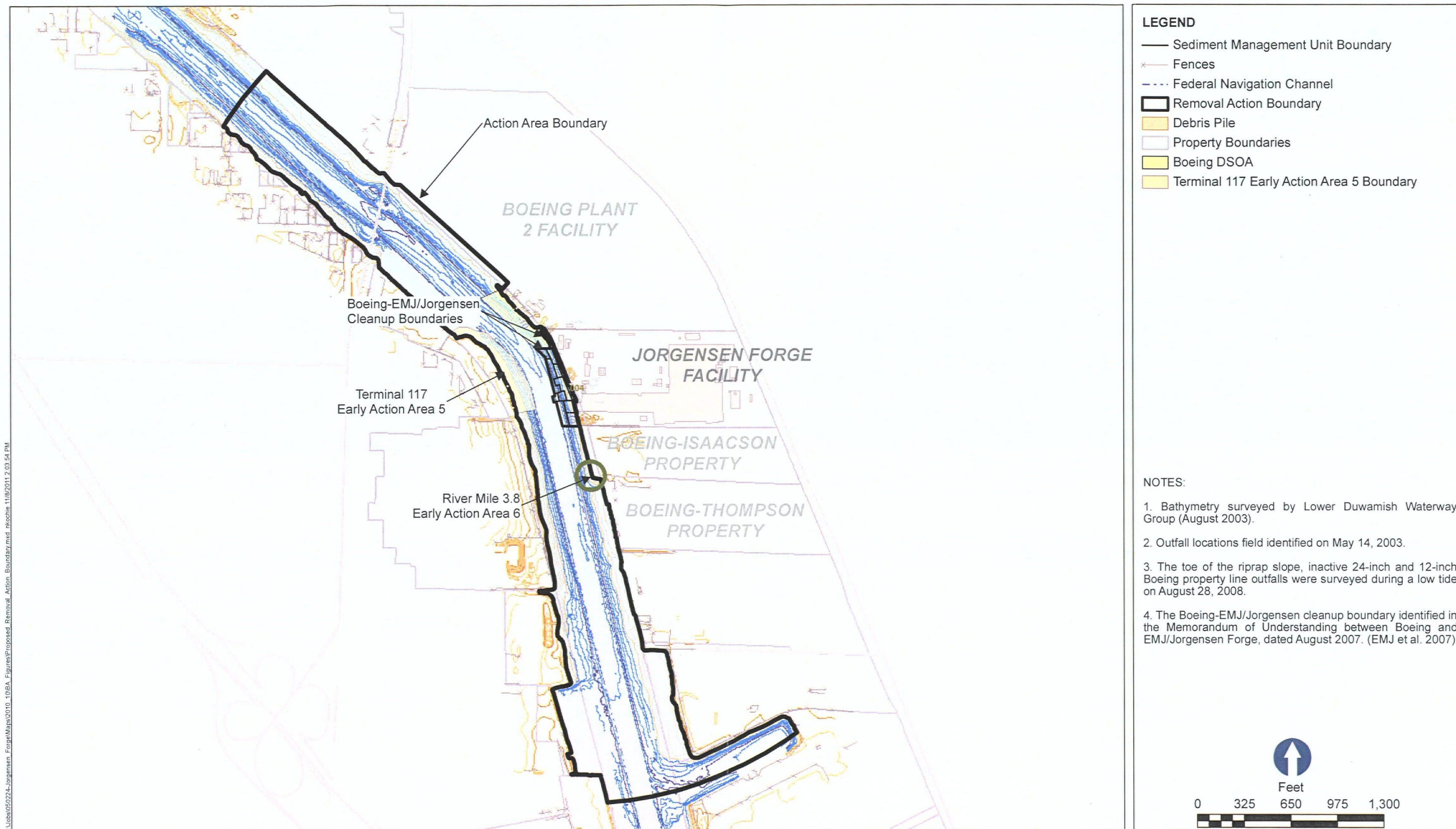


Figure 2
Proposed Action Area Boundary
Early Action Area 4 BA
Jorgensen Forge Facility

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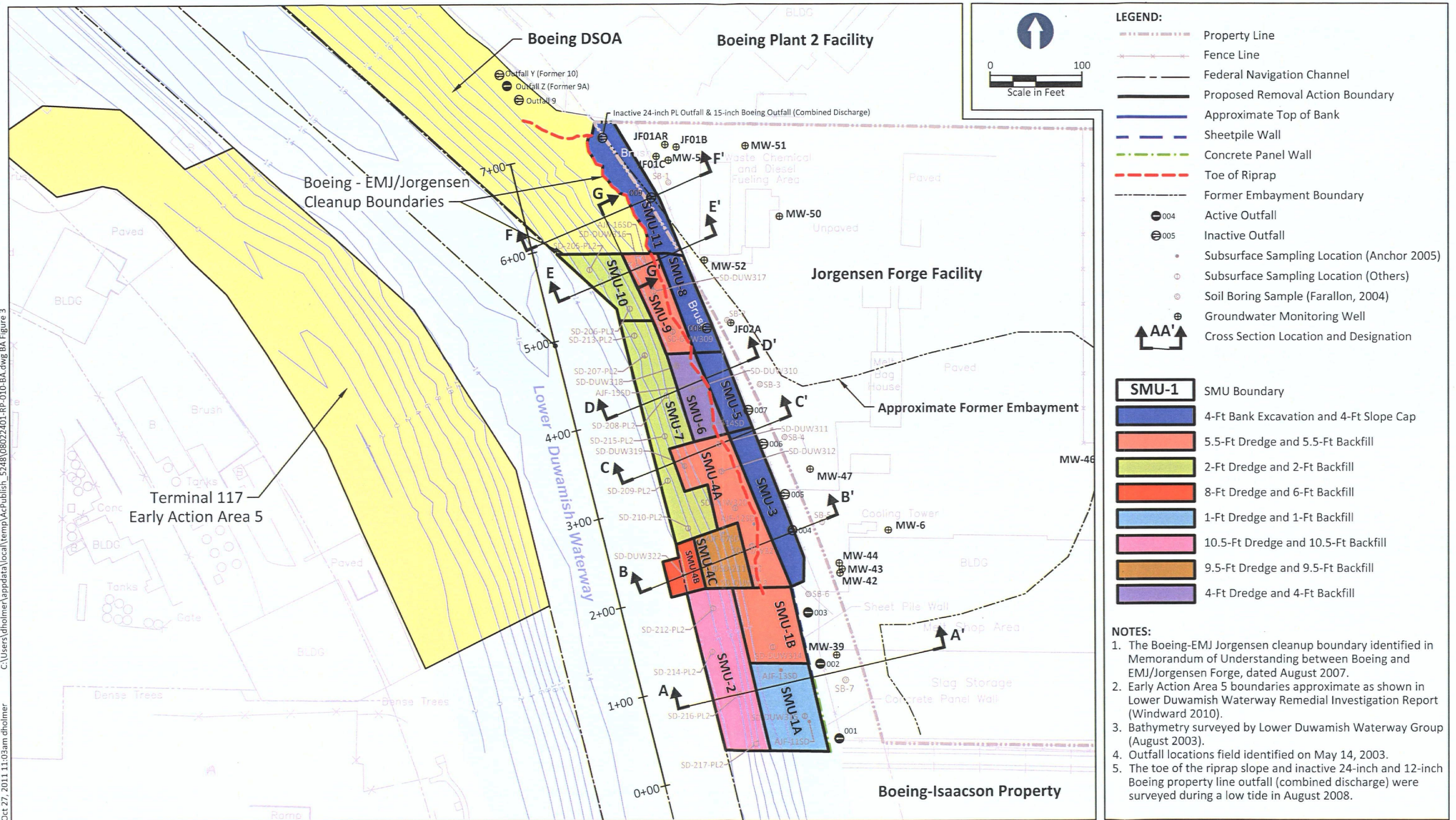
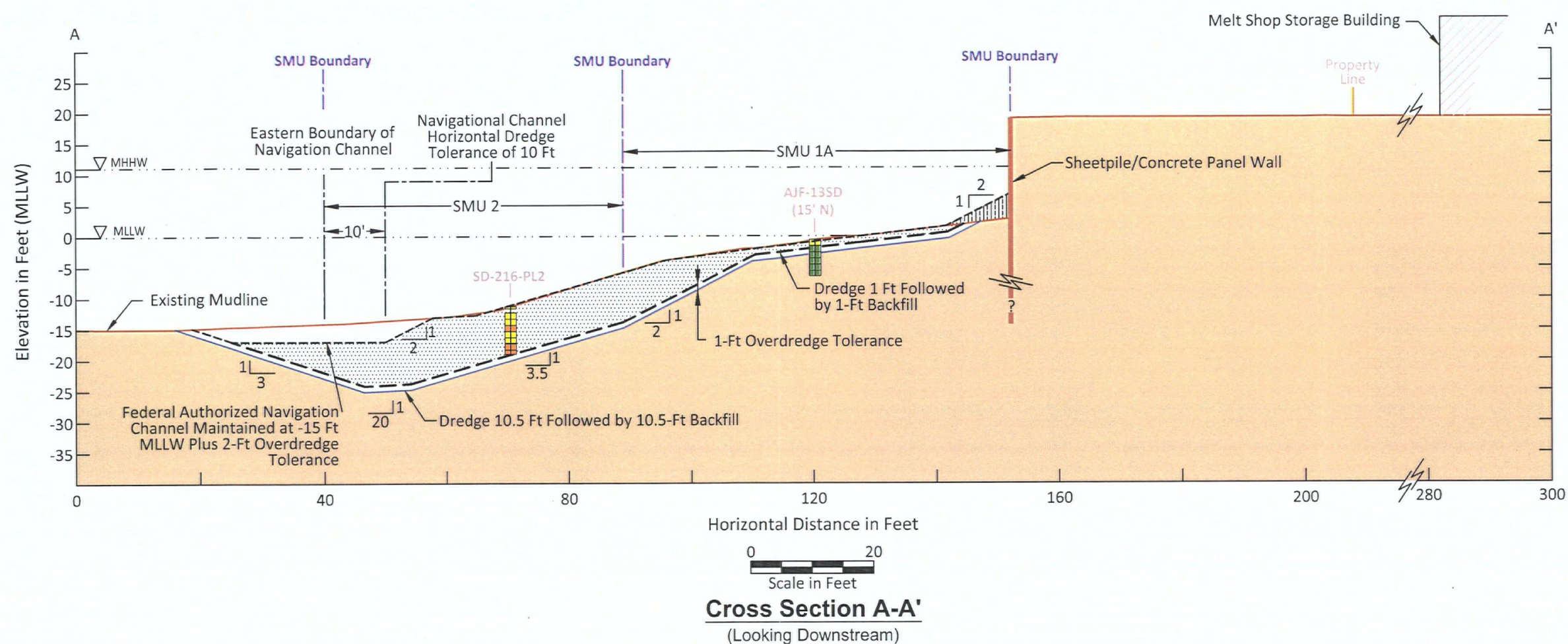


Figure 3
Proposed Action Site Plan
Early Action Area 4 BA
Jorgensen Forge Facility

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Oct 27, 2011 11:03am dholmer



LEGEND:

- SD-DUW310 (2' S) Core Sample Identification
Offset Distance in Feet
Core Sample Location
Sample Interval in Feet
- Greatest Concentration of Total PCBs and Metals Relative to SMS Criteria:
- <0.5 x SQS/LAET (<6 mg/kg OC or <65 µg/kg)
 - 0.5 x SQS/LAET - SQS/LAET (6 - 12 mg/kg OC or 65 µg/kg - 130 µg/kg)
 - SQS/2LAET - CSL/2LAET (12 - 65 mg/kg OC or 130 µg/kg - 1000 µg/kg)
 - CSL/2LAET - 2xCSL/2LAET (65 - 130 mg/kg OC or 1000 µg/kg - 2000 µg/kg)
 - 2xCSL/2LAET (>130 mg/kg OC or >2000 µg/kg)
 - Non-Detect Greater than the SQS/LAET Criteria (>12 mg/kg OC or >130 µg/kg)
 - Sample Not Taken

- Existing Mudline
- Post-Construction Grade
- Excavation Limit
- Overdredge Limit
- Volume to be Dredged and Backfilled
- Volume to be Backfilled

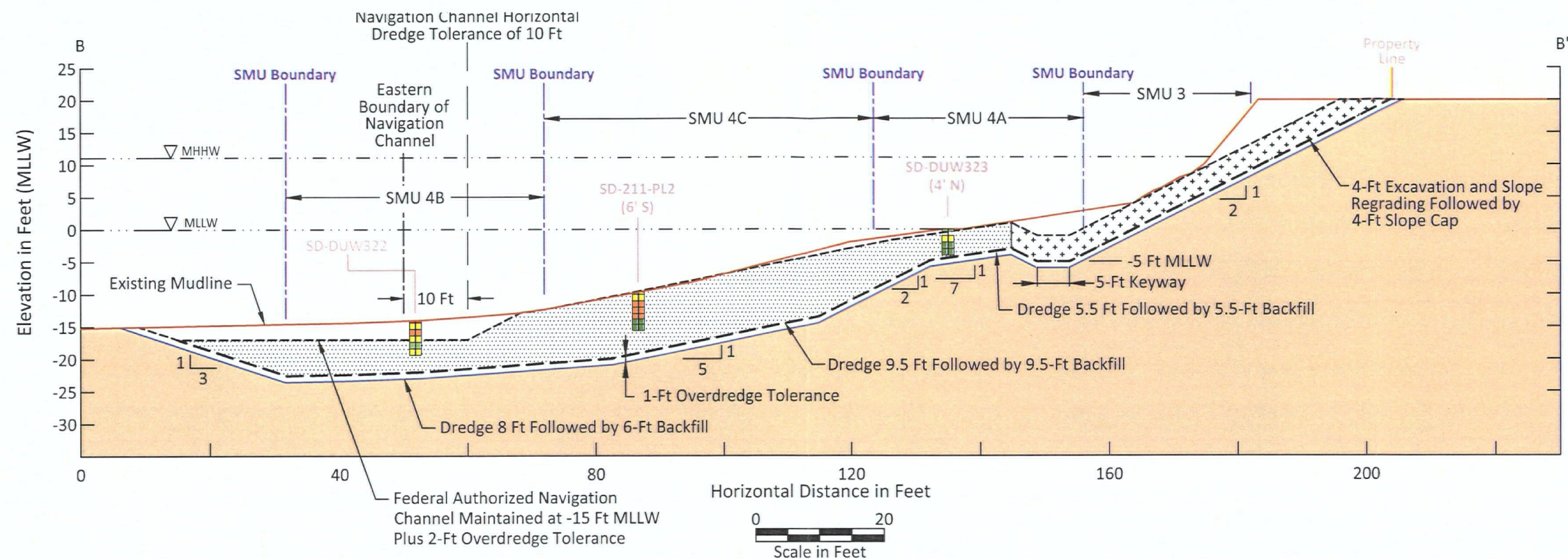
NOTES:

- Engineered cap to include isolation layer, erosion protection and habitat mix. Erosion protection requirements will vary by location, as determined during design.
- Federally authorized navigation channel last dredged at this location in 1999.
- Sediment samples were OC-normalized and compared to SQS and CSL Total PCBs criteria. Sediment samples with TOC <0.5% or TOC >3% were not OC-normalized and were compared to LAET and 2LAET Total PCBs criteria.
- Backfill material proposed in navigation channel to achieve stable slopes following removal outside the channel. No capping proposed in the navigation channel.
- Bathymetry surveyed by Lower Duwamish Waterway Group (August 2003).
- Subsurface sediment data queried from LDWG database (July 2010).
- Sediment Quality Standard (SQS) = 12 mg/kg OC
- Cleanup Screening Level (CSL) = 65 mg/kg OC
- Lowest Apparent Effects Threshold (LAET) = 130 µg/kg
- Second Lowest Apparent Effects Threshold (2LAET) = 1000 µg/kg
- Mean lower low water elevation = MLLW
- Mean higher high water elevation = MHHW



Figure 4a
Proposed Action Cross Section A-A'
Early Action Area 4 BA
Jorgensen Forge Facility

C:\Users\dholmer\appdata\local\temp\AcPublish_5248\08022401-RP-010-BA.dwg BA Figure 4b
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Cross Section B-B'
(Looking Downstream)

LEGEND:

SD-DUW310 (2' S)
Core Sample Identification
Offset Distance in Feet
Core Sample Location
Sample Interval in Feet

Greatest Concentration of Total PCBs
and Metals Relative to SMS Criteria:

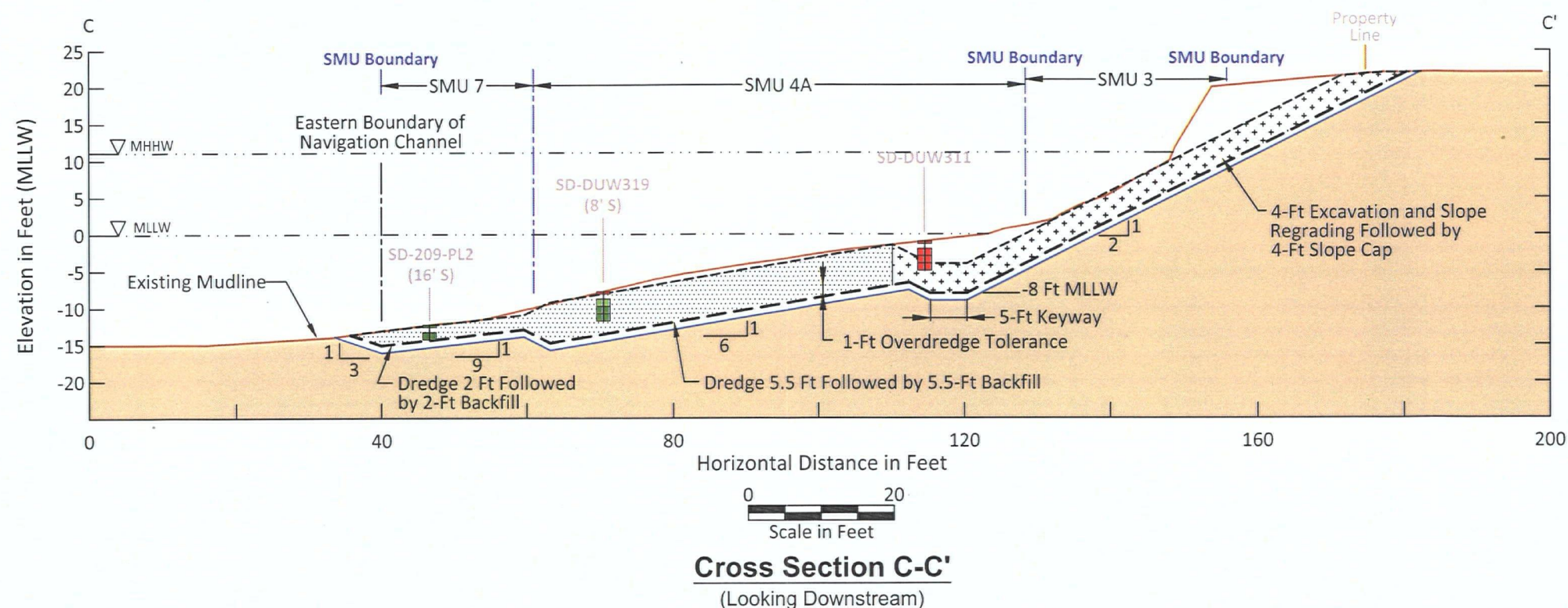
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- 0.5 x SQS/LAET - SQS/LAET (6 - 12 mg/kg OC or 65 µg/kg - 130 µg/kg)
- SQS/2LAET - CSL/2LAET (12 - 65 mg/kg OC or 130 µg/kg - 1000 µg/kg)
- CSL/2LAET - 2xCSL/2LAET (65 - 130 mg/kg OC or 1000 µg/kg - 2000 µg/kg)
- 2xCSL/2LAET (>130 mg/kg OC or >2000 µg/kg)
- Non-Detect Greater than the SQS/LAET Criteria (>12 mg/kg OC or >130 µg/kg)
- Sample Not Taken

- Existing Mudline
- Post-Construction Grade
- Excavation Limit
- Overdredge Limit
- Volume to be Dredged and Backfilled
- Volume to be Excavated and Capped

NOTES:

1. Engineered cap to include isolation layer, erosion protection and habitat mix. Erosion protection requirements will vary by location, as determined during design.
2. Federally authorized navigation channel last dredged at this location in 1999.
3. Sediment samples were OC-normalized and compared to SQS and CSL Total PCBs criteria. Sediment samples with TOC <0.5% or TOC >3% were not OC-normalized and were compared to LAET and 2LAET Total PCBs criteria.
4. Cap versus backfill designation to be determined based on sediment concentrations at bottom of designed removal elevation plus overdredge tolerance.
5. Backfill material proposed in navigation channel to achieve stable slopes following removal outside the channel. No capping proposed in the navigation channel.
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7. Subsurface sediment data queried from LDWG database (July 2010).
8. Sediment Quality Standard (SQS) = 12 mg/kg OC
9. Cleanup Screening Level (CSL) = 65 mg/kg OC
10. Lowest Apparent Effects Threshold (LAET) = 130 µg/kg
11. Second Lowest Apparent Effects Threshold (2LAET) = 1000 µg/kg
12. Mean lower low water elevation = MLLW
13. Mean higher high water elevation = MHHW

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LEGEND:

SD-DUW310
(2' S)
Core Sample Identification
Offset Distance in Feet
Core Sample Location
Sample Interval in Feet

Greatest Concentration of Total PCBs
and Metals Relative to SMS Criteria:

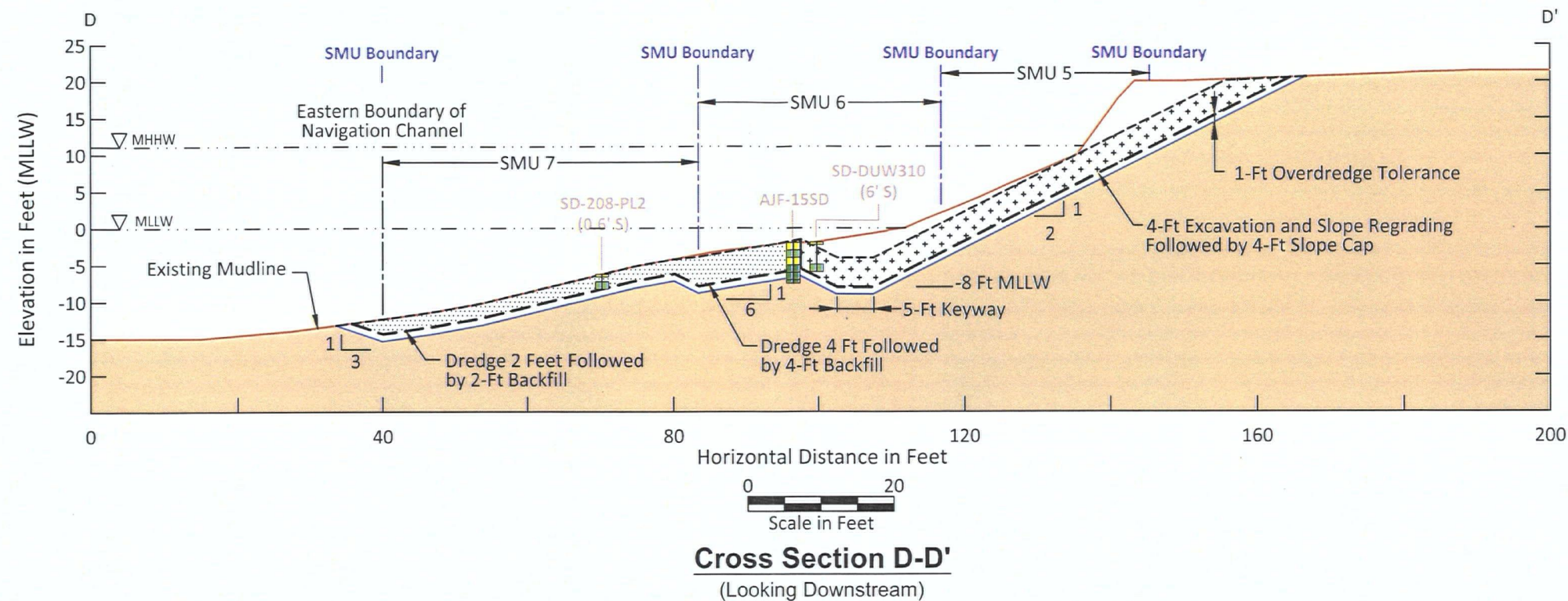
- <0.5 x SQS/LAET (<6 mg/kg OC or <65 µg/kg)
- 0.5 x SQS/LAET - SQS/LAET (6 -12 mg/kg OC or 65 µg/kg - 130 µg/kg)
- SQS/2LAET - CSL/2LAET (12 - 65 mg/kg OC or 130 µg/kg - 1000 µg/kg)
- CSL/2LAET - 2xCSL/2LAET (65 - 130 mg/kg OC or 1000 µg/kg - 2000 µg/kg)
- 2xCSL/2LAET (>130 mg/kg OC or >2000 µg/kg)
- Non-Detect Greater than the SQS/LAET Criteria (>12 mg/kg OC or >130 µg/kg)
- Sample Not Taken

- Existing Mudline
- Post-Construction Grade
- Excavation Limit
- Overdredge Limit
- Volume to be Dredged and Backfilled
- Volume to be Excavated and Capped

NOTES:

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2. Federally authorized navigation channel last dredged at this location in 1999.
3. Sediment samples were OC-normalized and compared to SQS and CSL Total PCBs criteria. Sediment samples with TOC <0.5% or TOC >3% were not OC-normalized and were compared to LAET and 2LAET Total PCBs criteria.
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7. Subsurface sediment data queried from LDWG database (July 2010).
8. Sediment Quality Standard (SQS) = 12 mg/kg OC
9. Cleanup Screening Level (CSL) = 65 mg/kg OC
10. Lowest Apparent Effects Threshold (LAET) = 130 µg/kg
11. Second Lowest Apparent Effects Threshold (2LAET) = 1000 µg/kg
12. Mean lower low water elevation = MLLW
13. Mean higher high water elevation = MHHW

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LEGEND:

SD-DUW310
(2' S)

Core Sample Identification

Offset Distance in Feet

Core Sample Location

Sample Interval in Feet

Greatest Concentration of Total PCBs
and Metals Relative to SMS Criteria:

<0.5 x SQS/LAET (<6 mg/kg OC or <65 µg/kg)

0.5 x SQS/LAET - SQS/LAET (6 - 12 mg/kg OC or 65 µg/kg - 130 µg/kg)

SQS/2LAET - CSL/2LAET (12 - 65 mg/kg OC or 130 µg/kg - 1000 µg/kg)

CSL/2LAET - 2xCSL/2LAET (65 - 130 mg/kg OC or 1000 µg/kg - 2000 µg/kg)

2xCSL/2LAET (>130 mg/kg OC or >2000 µg/kg)

Non-Detect Greater than the SQS/LAET Criteria (>12 mg/kg OC or >130 µg/kg)

Sample Not Taken

Existing Mudline

Post-Construction Grade

Excavation Limit

Overdredge Limit

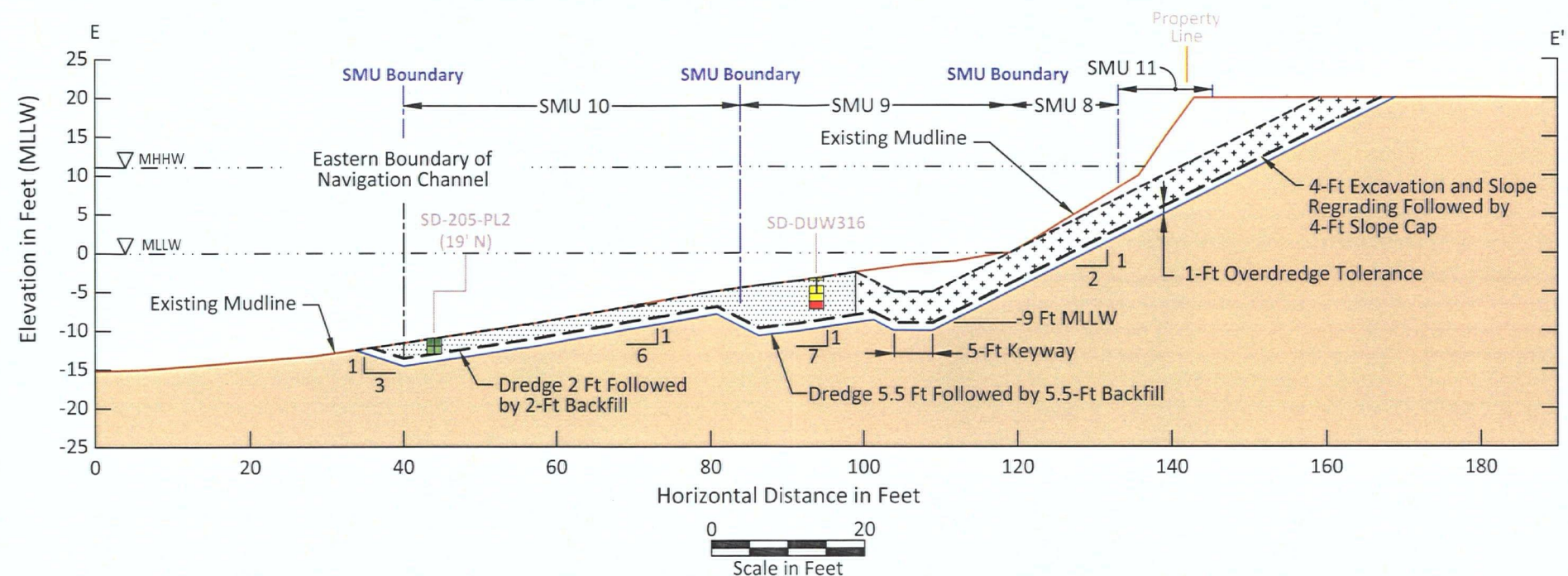
Volume to be Dredged and Backfilled

Volume to be Excavated and Capped

NOTES:

1. Engineered cap to include isolation layer, erosion protection and habitat mix. Erosion protection requirements will vary by location, as determined during design.
2. Federally authorized navigation channel last dredged at this location in 1999.
3. Sediment samples were OC-normalized and compared to SQS and CSL Total PCBs criteria. Sediment samples with TOC <0.5% or TOC >3% were not OC-normalized and were compared to LAET and 2LAET Total PCBs criteria.
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7. Sediment Quality Standard (SQS) = 12 mg/kg OC
8. Cleanup Screening Level (CSL) = 65 mg/kg OC
9. Lowest Apparent Effects Threshold (LAET) = 130 µg/kg
10. Second Lowest Apparent Effects Threshold (2LAET) = 1000 µg/kg
11. Mean lower low water elevation = MLLW
12. Mean higher high water elevation = MHHW

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Oct 27, 2011 11:03am dholmer



Cross Section E-E'
(Looking Downstream)

LEGEND:

SD-DUW310
(2' 5')
Core Sample Identification
Offset Distance in Feet
Core Sample Location
Sample Interval in Feet

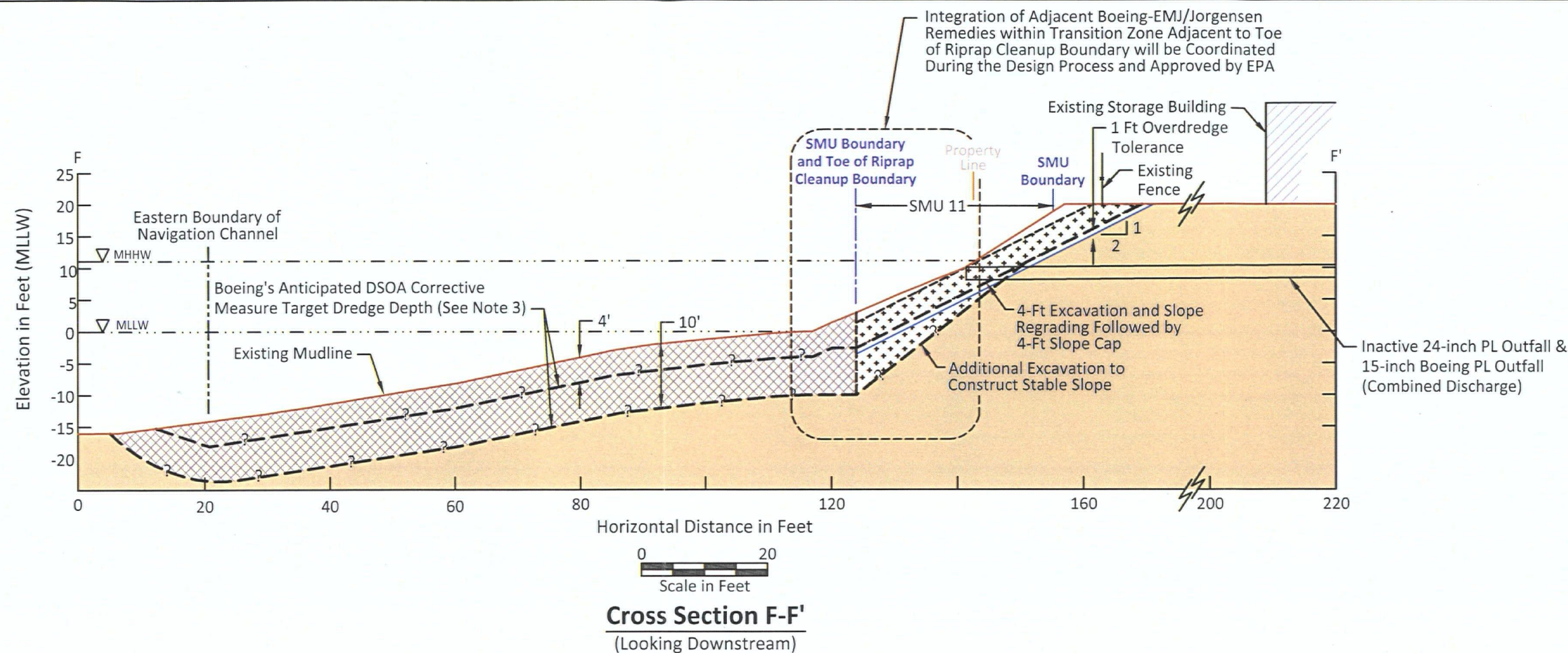
Greatest Concentration of Total PCBs
and Metals Relative to SMS Criteria:

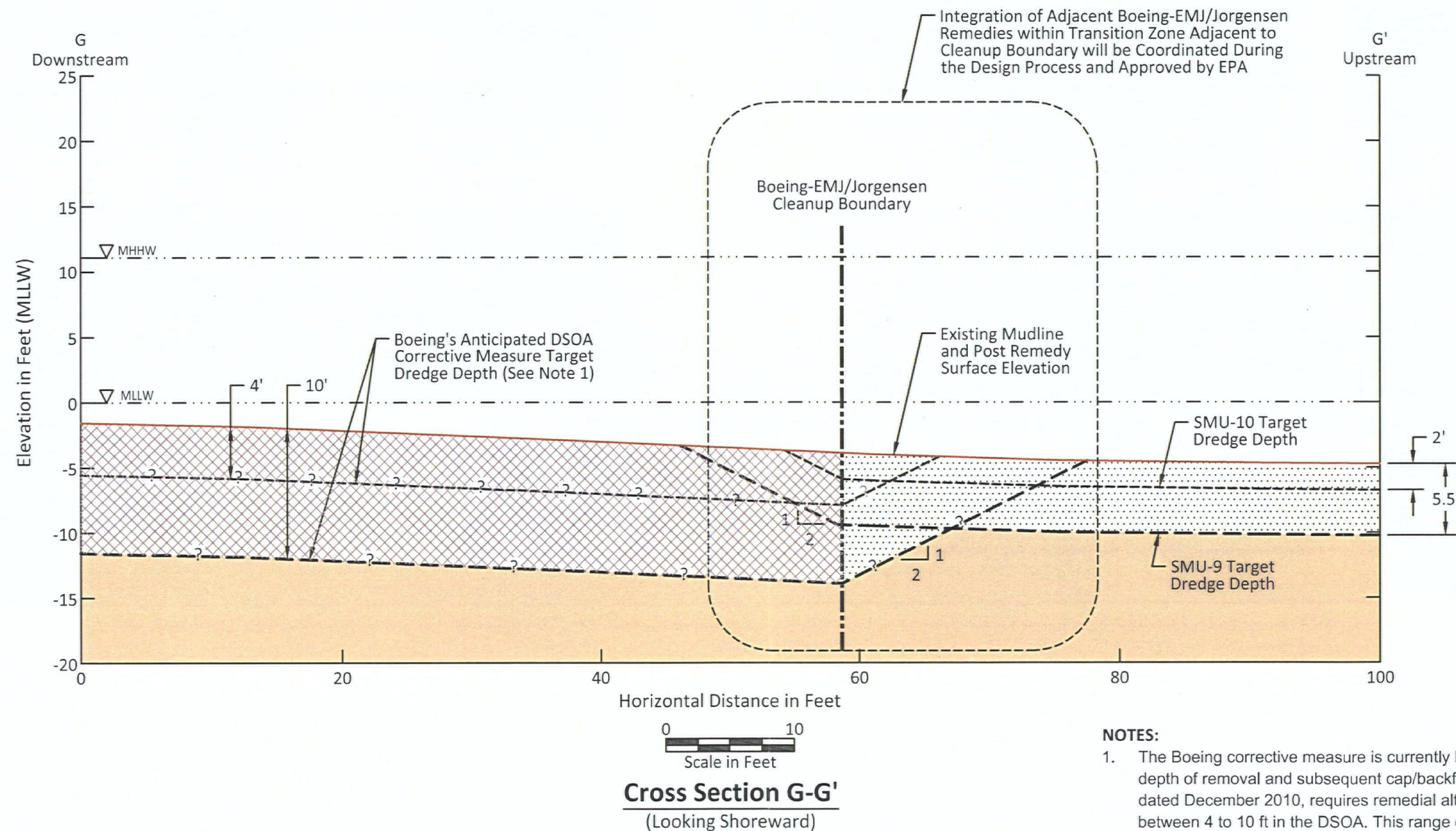
- <0.5 x SQS/LAET (<6 mg/kg OC or <65 µg/kg)
- 0.5 x SQS/LAET - SQS/LAET (6 - 12 mg/kg OC or 65 µg/kg - 130 µg/kg)
- SQS/2LAET - CSL/2LAET (12 - 65 mg/kg OC or 130 µg/kg - 1000 µg/kg)
- CSL/2LAET - 2xCSL/2LAET (65 - 130 mg/kg OC or 1000 µg/kg - 2000 µg/kg)
- 2xCSL/2LAET (>130 mg/kg OC or >2000 µg/kg)
- Non-Detect Greater than the SQS/LAET Criteria (>12 mg/kg OC or >130 µg/kg)
- Sample Not Taken

- Existing Mudline
- Post-Construction Grade
- Excavation Limit
- Overdredge Limit
- Volume to be Dredged and Backfilled
- + Volume to be Excavated and Capped

NOTES:

1. Engineered cap to include isolation layer, erosion protection and habitat mix. Erosion protection requirements will vary by location, as determined during design.
2. Federally authorized navigation channel last dredged at this location in 1999.
3. Sediment samples were OC-normalized and compared to SQS and CSL Total PCBs criteria. Sediment samples with TOC <0.5% or TOC >3% were not OC-normalized and were compared to LAET and 2LAET Total PCBs criteria.
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6. Bathymetry surveyed by Lower Duwamish Waterway Group (August 2003).
7. Subsurface sediment data queried from LDWG database (July 2010).
8. Sediment Quality Standard (SQS) = 12 mg/kg OC
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10. Lowest Apparent Effects Threshold (LAET) = 130 µg/kg
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12. Mean lower low water elevation = MLLW
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APPENDIX A
ESSENTIAL FISH HABITAT EVALUATION

ESSENTIAL FISH HABITAT EVALUATION

Pursuant to the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) and the 1996 Sustainable Fisheries Act, an Essential Fish Habitat (EFH) evaluation of impacts is necessary for activities that are associated with the removal action for affected sediments and associated shoreline bank within the Lower Duwamish Waterway (LDW) Superfund Site adjacent to a portion of the Jorgensen Forge Corporation (Jorgensen Forge) facility (Facility) located at 8531 East Marginal Way South in Seattle, Washington. EFH is defined by the Magnuson-Stevens Act (in 50 CFR 600.905-930) as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity” and is designated for groundfish, Pacific salmon, and coastal pelagic composites.

Identification of Essential Fish Habitat in the Action Area

The Action Area for the proposed project includes habitats that have been designated as EFH for the groundfish and Pacific salmon EFH composites.

Designated EFH for groundfish composite species encompasses all waters from the mean high water line and upriver extent of saltwater intrusion in river mouths, along the coasts of Washington, Oregon, and California, seaward to the boundary of the United States exclusive economic zone (370.4 kilometers; PFMC 1998a, 1998b). Groundfish EFH is discussed in detail in the *Final Environmental Assessment/Regulatory Review for Amendment 11 to the Pacific Coast Groundfish Fishery Management Plan* (PFMC 1998a) and National Marine Fisheries Service’s (NMFS) *Essential Fish Habitat for West Coast Groundfish Appendix* (NMFS 1998).

Freshwater EFH for Pacific salmon includes those streams, lakes, ponds, wetlands, and other waterbodies currently or historically accessible to salmon in Washington, Oregon, Idaho, and California, except areas upstream of certain impassable constructed barriers (as identified by the Pacific Fisheries Management Council [PFMC]), and longstanding, naturally-impassable barriers (that is, natural waterfalls in existence for several hundred years; PFMC 1999). Salmonid EFH is discussed in detail in Appendix A of Amendment 14 to the Pacific Coast Salmon Plan (PFMC 1999). EFH and life history stages for species that are likely to occur in the Action Area were listed in Table A-1, based on sampling done as part of the Remedial Investigation (RI; Windward 2010).

Table A-1
Species of Fishes and Life-History Stages with Designated Essential Fish Habitat in the
Estuarine Waters of Puget Sound and that May Occur in the Action Area

Species	Adult	Spawning/ mating	Juvenile	Larvae	Eggs/ Parturition
Groundfish Species					
English sole	X	X	X	X	X
Starry flounder	X	X	X	X	X
Pacific Salmon Species					
Chinook salmon	X		X		
Coho salmon	X		X		
Puget Sound pink salmon	X		X		

Notes:

Table modified from the Northwest Region (NWR) EFH website:

<http://www.nwr.noaa.gov/1habcon/habweb/msa.htm>

Effects of the Proposed Action and Effects Determination

The assessment of potential impacts from the proposed project to the species' EFH is based on information in previous sections of this Biological Assessment (BA). Impacts may occur because of the proposed action, as considered in the following subsection.

Direct and Indirect Effects to Essential Fish Habitat

Direct and indirect effects on EFH and the impact avoidance, minimization, and conservation measures that avoid and minimize impacts are identified in Table 2. Overall, the expected outcome of the proposed action will be significantly reduced exposure to existing contamination in sediments, which will improve overall EFH and aquatic ecosystem health.

Table A-2
Affected EFH by Project Element and Proposed Conservation Measures

Project Element	Affected EFH	Impact Discussion	Impact Avoidance and Minimization and Conservation Measures
Dredging/excavation and material placement	Groundfish and salmonid EFH (Substrate and habitat conversion)	<p>Dredging/excavation and placement of import material will temporarily disturb existing benthic organisms and habitat; however, existing conditions indicate that there is poor production of epibenthic and benthic prey in these areas. Additionally, it is expected that the benthic communities would begin recolonizing rapidly after disturbance. Thus, it is expected that impacts to fish via disturbance of the epibenthic prey community are not expected to affect the abundance or availability of typical prey/forage organisms for salmonids and groundfish.</p> <p>In addition, groundfish and salmonids are mobile and generally able to distinguish and avoid areas where prey are less abundant. If available, groundfish species could selectively use undisturbed or recolonized areas in the project vicinity for foraging.</p> <p>No net loss of EFH is expected to occur.</p> <p>In general, this work will convert some steep shoreline areas into shallow water nearshore habitat. This habitat conversion will serve to improve EFH over the long term because acreage will increase in lower and upper intertidal zones where young fish tend to feed and rear. Also, given the context of the Action Area in an industrialized reach of the LDW, although short-term habitat impacts to EFH substrates</p>	<p>Impact avoidance and minimization and conservation measures include those listed in the accompanying BA in Section 2.1.</p> <p>In addition, in-water work for the project will comply with the timing restrictions specified in the in-water work window, when salmonids are expected to be either not present or present in very low numbers.</p> <p>Post-project conditions of nearshore habitat will provide improved habitat benefits for salmonids and groundfish relative to existing conditions, as the overall effect of the action will provide improved chemical and physical substrate conditions for listed species.</p>

Project Element	Affected EFH	Impact Discussion	Impact Avoidance and Minimization and Conservation Measures
		<p>will occur, the long-term effect of the proposed action on EFH is anticipated to be beneficial. The project is not expected or intended to reduce EFH quality; rather, the project will serve to increase EFH value by removing contaminated sediments from the environment.</p> <p>Substrates will be disturbed, but not degraded over the long term. Substrate quality is already limited in the Action Area, as substrates are contaminated and require remediation. Dredging would remove a significant amount of contaminated material from the LDW, and backfill will minimize the amount of habitat conversion, as well as provide a clean surface substrate, which is considered a substantial habitat benefit.</p> <p>Moreover, the net effect and intention of the new substrate surface is to provide a habitat benefit to fishery species.</p> <p>The overall impact of work in this shoreline area is expected to be minimal because existing conditions in the project area are already heavily industrialized and fish use of the area is likely compromised.</p>	
Dredging/excavation and material placement	Groundfish and salmonid EFH (Water Quality)	Suspended sediment and chemical contaminant concentrations in water column EFH could be temporarily elevated over baseline conditions. Thus, short-term effects to water quality are expected to occur related to the proposed action, and specifically, the dredging/excavation activities. Resuspension of sediments and contaminants may occur during in-water work, but impact avoidance and	<p>Impact avoidance and minimization and conservation measures include those listed in the accompanying BA in Section 2.1.</p> <p>In addition, in-water work for the project will comply with the timing restrictions specified in the in-water work window, when salmonids are</p>

Project Element	Affected EFH	Impact Discussion	Impact Avoidance and Minimization and Conservation Measures
		<p>minimization and conservation measures will be implemented to minimize effects on water quality.</p> <p>In addition, suspension of sediment has the potential to adversely affect water column EFH by reducing dissolved oxygen (DO). High concentrations of suspended sediments have the potential to reduce DO levels by exposing nutrients to bacterial breakdown (Mortensen et al. 1976). A model created by LaSalle (1988) demonstrated that even in a situation where the upper limit of expected suspended sediment is reached during dredging operations, DO depletion of no more than 0.1 milligrams per liter (mg/L) would occur at depth. LaSalle (1988) concluded that based on the relatively low levels of suspended material generated by dredging operations, and considering factors such as flushing, DO depletion around these activities should be minimal.</p> <p>Water column EFH could be adversely affected by spills from construction equipment. There is a small chance that an unintentional release of fuel, lubricants, or hydraulic fluid from the construction equipment could lead to adverse impacts to salmonid or groundfish EFH.</p> <p>Because fish in the Action Area are mobile, they would be expected to avoid areas where unsuitable conditions exist. For this reason, the effects of the project on water column EFH are expected to be minimal.</p>	<p>expected to be either not present or present in very low numbers.</p> <p>Water quality monitoring will occur concurrent with the proposed action in accordance with the Water Quality Certification that will be issued for the project.</p> <p>In addition, surface booms, oil-absorbent pads, and similar materials will be on site for any accidental construction equipment spills.</p>

Effects Determination for Essential Fish Habitat

Based on the previous information, the effects of the proposed action will not adversely affect Pacific Coast Salmon EFH, coastal pelagic EFH, and West Coast Groundfish EFH. A “will not adversely affect” determination is appropriate because there will be short-term impacts to substrate and water quality in the Action Area as described in Table A-2, but long-term beneficial effects to EFH are expected as a result of the project based on the reduction of sediment contamination from the EFH environment. Impact avoidance, minimization, and conservation measures that avoid and minimize impacts to EFH are incorporated into the project design, and with the implementation of these measures and the habitat improvements resulting from removal of contaminated sediments, the project is expected overall to result in long-term, beneficial effects to groundfish and salmonid species EFH.

REFERENCES

- LaSalle, M.W., 1988. Physical and chemical alterations associated with dredging: an overview. Pages 1-12 in C.A. Simenstad, ed. Effects of dredging on anadromous Pacific coast fishes. University of Washington, Seattle, Washington.
- Mortensen, D.G., B.P. Snyder, and E.O. Salo, 1976. An analysis of the literature on the effects of dredging on juvenile salmonids. University of Washington. Fisheries Research Institute, FRI-UW-7605.
- National Marine Fisheries Service (NMFS), 1998. Essential Fish Habitat West Coast Groundfish Appendix. NMFS, Seattle, Washington.
- Pacific Fishery Management Council (PFMC), 1998a. Final Environmental Assessment/Regulatory Review for Amendment 11 to the Pacific Coast Groundfish Fishery Management Plan. Pacific Fishery Management Council, Portland, Oregon, (October 1998).
<http://www.pcouncil.org/groundfish/gffmp/gfa11.html>
- PFMC, 1998b. Coastal Pelagics Fishery Management Plan. Pacific Fisheries Management Council, Portland, Oregon.
- PFMC, 1999. Amendment 14 to the Pacific Coast Salmon Plan. Appendix A. Identification and Description of Essential Fish Habitat, Adverse Impacts, and Recommended Conservation Measures for Salmon. PFMC, Portland, Oregon. 146 pgs.
<http://www.pcouncil.org/salmon/salfmp/a14.html>.
- Windward Environmental, LLC 2010. Final Remedial Investigation Report, Lower Duwamish Waterway. Prepared for Lower Duwamish Waterway Group for submittal to U.S. Environmental Protection Agency, Seattle, Washington and Washington Department of Ecology, Bellevue, Washington. July 2010.